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...IAL INFORMATION

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PANJAB UNIVERSITY

Applications are invited for the undermentioned posts of Professors, Readers and Lecturers—Grade Rs. 800-50-1,250, Rs. 500-30-800 and Rs. 250-20-450-E.B.-25-650 respectively, with benefit of Provident Fund on confirmation and allowances as admissible under the University rules. Higher starting pay in the grade depending upon qualifications and experience is admissible.

Candidates for the posts of Professors should have brilliant academic career followed by outstanding research work in the subject. They should have experience of teaching to Post-graduate classes or experience of post-doctoral research of about 10 years and should be competent to guide research.

Candidates for the posts of Readers should have the Master or Doctorate or an equivalent degree in the subject concerned. They should have bright academic record, considerable research experience as indicated by published work and experience of teaching or post-doctoral research of about five years.

Candidates for the posts of Lecturers should be at least M.Sc. or M.A. second class or possess an equivalent Degree, and preferably a Doctorate Degree in the subject concerned. They should have published research work to their credit. Teaching experience with Post-Graduate Classes will be an additional qualification.

Candidates for the post of Lecturer in Pharmaceutics in Pharmacy Department should be registered Pharmacists under the Pharmacy Act and should have at least two years manufacturing experience.

Chemistry Department

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Candidates for Social Anthropology should have done fieldwork among the Tribal and non-Tribal people and for Physical Anthropology should have experience of Genetical Surveys, Blood Groups, Dermatoglyphics as well as some training in Prehistoric Archæology.

Physics Department

Professor (Experimental Physics)—1; Readers (Experimental Physics)—2; (One preferably with special knowledge of X-rays and Radioactivity); Professor of Physics (Theoretical Physics)—1; Reader (Theoretical Physics)—1

Geology Department

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Reader in Pharmacology—1; Lecturer in Pharmaceutical Chemistry—1 (with experience of Drug Analysis); Lecturer in Pharmacognosy—1; Lecturer in Physiology—1; Lecturer in Pharmaceutics—1

Applications stating age, academic qualifications, teaching and research experience along with copies of publications, University certificates, etc., should reach the **Registrar, Panjab University, Chandigarh, by April 15, 1960.**

PANJAB UNIVERSITY

Applications are invited for the following posts in the Department of Chemical Engineering and Technology in the grades noted against each. The persons appointed will be further entitled to the allowances as admissible under the University rules and to the benefit of Provident Fund on confirmation. Higher starting pay in the grade depending upon qualifications and experience is admissible.

1. Director-*cum*-Professor. (Grade Rs. 1,000-50-1,750)—ONE

Candidates should have brilliant academic career followed by outstanding research work in the field of Chemical Engineering or Chemical Technology. They should have experience of teaching to Post-Graduate Classes or experience of post-doctoral research of about 10 years and should be competent to guide research. Experience of Industry will be an additional qualification.

2. Professor. (Grade Rs. 800-50-1,250)—ONE

Candidates should be eminent in some branch of Chemical Engineering and should have experience of teaching in such fields as Thermodynamics, Kinetics or the application of Mathematics to Chemical Engineering Problems. Experience of Industry will be an additional qualification.

3. Readers. (Grade Rs. 500-30-800)—THREE

(One in Chemical Engineering, one in Inorganic Chemical Technology and one in Mechanical Engineering)

Candidates should have the Master or Doctorate or an equivalent degree in the subject concerned. They should also have some research experience as indicated by published work and experience of teaching or post-doctoral research of about five years. Some experience of Industry will be an additional qualification.

Candidates for the post of Reader in Chemical Engineering should be able to teach Graduate Classes in Mass-transfer, Kinetics, Thermodynamics or Application of Mathematics to Chemical Engineering.

4. Lecturers. (Grade Rs. 250-20-450-E.B.-25-650)—FIVE

(Three in Chemical Engineering, one in Inorganic Chemistry and one in Mathematics with interest in the Scientific and Computor fields)

Candidates should be at least M.Sc. Second Class or possess an equivalent degree. A Doctorate Degree in the subject concerned and published research work will be additional qualifications.

Applications stating age, academic qualifications, teaching and research experience along with copies of publications, University certificates, etc., should reach the **Registrar, Panjab University, Chandigarh, by April 15, 1960.**

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NEW FERRO- AND ANTIFERROELECTRIC CRYSTALS

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THE subject ferroelectricity has gained considerable importance in recent years due to the fact that it poses many intriguing and fundamental problems in solid state physics and also because some of the ferroelectric crystals, even in ceramic form, found immediate industrial applications like electromechanical transducers, electrical condenser materials, etc. It may be remarked here that the terms *ferroelectrics* and *ferroelectricity* are based solely on the analogy between the electrical properties of certain crystals like Rochelle salt, KH_2PO_4, etc., and the magnetic properties of ferromagnetic materials. Just as ferromagnetics show a hysteresis effect in relationship to magnetic induction and field, ferroelectrics show hysteresis in dielectric displacement D *vs.* applied electric field E. The existence of a dielectric hysteresis loop in any crystal implies that the crystal is spontaneously electrically polarized. In typical ferroelectrics spontaneous polarization diminishes as the crystal is heated, and it disappears at a temperature called the *ferroelectric Curie point*. The dielectric constant ϵ in the direction of spontaneous polarization is generally high and shows a high peak at the Curie point T_c ; above this temperature further heating results in a rapid decrease of the dielectric constant according to the Curie-Weiss law

$$\epsilon = \epsilon_0 + \frac{C}{T-\theta}.$$

Here ϵ_0 represents the electronic contribution to the dielectric constant, C the Curie constant, T the absolute temperature and θ the characteristic temperature. θ either coincides with the transition temperature T_c or is a few degrees lower than it, depending on whether the transition is of the second or the first kind.

The spontaneous polarization is accompanied by a spontaneous strain consequent upon the atomic shifts taking place within the lattice. Hence the piezoelectric moduli and the elastic constants, which are connected with the spontaneous strain, also exhibit anomalies at the Curie temperature. Moreover, there will generally be an anomaly of the specific heat at the transition temperature and the shape of this anomaly will depend on the nature of the transition. Further due to the polarization and strain, the symmetry of the crystal in its ferroelectric phase is lower than that of the paraelectric phase. This departure from the higher symmetry is slight and a macroscopic ferroelectric crystal generally consists of multiple twins. In each twin-individual or the *domain* as it is called, the spontaneous polarization is directed along a specific crystallographic direction. Adjacent domains are oriented at various angles to one another crystallographically and hence polarized in different directions. Domain orientations can be altered by the application of an electric field and this domain reorientation is responsible for the D *vs.* E hysteresis loop.

It is well known that of the 32 crystal classes into which all the crystals can be divided from purely symmetry considerations, 21 classes lack centre of symmetry. Of these 21 classes, 20 are piezoelectric, i.e., these crystals become polarized under the influence of external stresses. 10 out of the 20 piezoelectric classes are called *pyroelectric*. Crystals in these latter classes are already polarized ; but the electrical polarization in these crystals is in general masked by surface charge and twinning. However it can usually be observed if the temperature of the crystal is altered whereby a *change* in the polarization of the crystal is induced. Occasionally the direction of polarity of a pyroelectric crystal can be reversed by the application of an electric field and such reversible pyroelectrics are called ferroelectrics. In other words, while the presence of piezo- or pyroelectricity can be deduced as soon as the crystal class is established (by morphological or X-ray methods), only dielectric measurements alone can establish the presence of ferroelectricity. Thus the latter word is a dielectric term and not a crystallographic term.

Certain other crystals like $NH_4H_2PO_4$, $PbZrO_3$, etc., exhibit phase transitions above which temperature the dielectric constant behaves as it does above a ferroelectric Curie point. But below the transition temperature no spontaneous polarization occurs and hence no hysteresis loop can be observed in these crystals. In such cases it may be possible to interpret the phenomenon as arising due to the arrangement of dipoles in an antiparallel array so as to give no net polarization. In other words the crystal structure of the low-temperature phase can be described in terms of equivalent sublattices with equal but opposite polarization. Thus a structural

study is necessary before such an arrangement can be established. In such cases the crystals are called *Antiferroelectric*. $NH_4PF_6.NH_4F$[1] and $CsH_3(SeO_3)_2$[2] are two new antiferroelectrics with transition temperatures at $-101°$ C. and $-120°$ C. respectively.

Till about four years ago all the ferroelectrics known up to that time could be broadly classified into the following three families: (i) the tartarate family (*e.g.*, Rochelle salt), (ii) the dihydrogen phosphate family (*e.g.*, KH_2PO_4) and (iii) the oxygen octahedra family (*e.g.*, $BaTiO_3$, $Cd_2Nb_2O_7$, etc.). The various excellent reviews[3-6] which appeared around that time have discussed in detail the dielectric, X-ray, thermal, optical and domain configuration properties of these crystals, as well as the various theories of ferroelectricity that have been developed to explain this most interesting phenomenon.

Since then ferroelectric transitions have been discovered in numerous crystals and in this article are collected some of the important properties of these new ferroelectrics. Incidentally, it may be mentioned that one of the main motivating forces for the search for new ferroelectrics has been the urgent need for a suitable material that can conveniently be used as the memory device in modern high-speed computers. Ferroelectric crystals, by virtue of their capability to exhibit the phenomenon of dielectric hysteresis, would obviously be the first choice for such storage elements. In fact, a small crystal of dimensions $2{\cdot}5 \times 2{\cdot}5 \times 0{\cdot}05$ cm. after being suitably electroded can be used to store as many as 900 *bits* of information.

Table I lists the various new ferroelectrics along with their transition temperatures, the spontaneous polarization, and the coercive field. The crystal symmetry above and below the transition temperature is also entered in the table along with the polar axis. The last column in the table gives the references. The values of the coercive field entered in the table may be considered as only to indicate the order of magnitude of the coercive field in these crystals, since they depend on numerous factors like the applied electric field, the geometry and the previous history of the sample, etc.

The terms GASH and MASD, entered in the table, are the accepted notations for Guanidinium Aluminium Sulphate Hexahydrate $C(NH_2)_3Al(SO_4)_2.6H_2O$, and Methylammonium Aluminium Sulphate Dodecahydrate $CH_3NH_3Al(SO_4)_2.12H_2O$ respectively. MASD is actually a typical representative of a large family of ferroelectrics, namely, the ammonium and methylammonium alums, the ferroelectric transitions in which have recently been discovered by Prof. Pepinsky and his collaborators.[8] The crystals GASH, $Li(N_2H_5)SO_4$, $(glycine)_2MnCl_2.2H_2O$, and $LiH_3(SeO_3)_2$ crystallize at room temperature in the ferroelectric phase and furthermore these crystals either decompose or melt before the Curie point is reached. Hence the transition temperatures of these crystals have not been recorded and the values of other constants of these crystals entered in the table correspond to those observed at room temperature.

On the other hand in the crystals $Na(NH_4)SO_4.2H_2O$, $CH_2ClCOONH_4$, and $(NH_4)_2Cd_2(SO_4)_3$ it has not been possible to determine the crystal symmetry of the low-temperature phase because of certain experimental difficulties like the instability of the crystal or the appearance of pronounced twinning in the crystal as it is cooled through the transition temperature. However, the probable space-groups of the low-temperature phase of these crystals can be derived from thermodynamic considerations and such data are also entered in the table.

It is seen that $(NH_4)_2SO_4$ and $(NH_4)_2BeF_4$ are not exactly isomorphous with each other as is generally believed, for even the polar directions in the ferroelectric phase of these two crystals are not along the same crystallographic axis. NH_4HSO_4 becomes ferroelectric below $-3°$ C. but loses this property below $-119°$ C. at which temperature the crystal undergoes yet another transition. The symmetry of the lowest-temperature phase is triclinic with the space-group Pl. In other words, apart from Rochelle salt, this is the first crystal in which the ferroelectric phase is sandwiched between two paraelectric phases. No such second transition could, however, be detected in the isomorphous crystal $RbHSO_4$. KNO_3 also exhibits somewhat similar phenomenon in that, ferroelectricity appears between 124° C. and 110° C., *only* when the crystal is cooled from a higher temperature. On warming, however, this crystal is transformed from the room temperature phase (space-group Pmmm) directly to the high temperature phase (space-group $R\bar{3}c$) at 124° C. without passing through the intermediate ferroelectric phase.

Amongst the many crystals containing glycine, $(glycine)_3.H_2SO_4$, which crystallizes in the ferroelectric phase at room temperature, exhibits many advantageous properties like high spontaneous polarization, fairly low coercive

TABLE I

Values of the transition temperature T_c (in °C.), the spontaneous polarisation P_s (in μcoul./cm.^{2}), the coercive field E_c (in kv./cm.), the crystal symmetry in the para- and ferroelectric phases, and the polar axes of the new ferroelectrics

(P_s and E_c values are given for temperature ~ 10° below transition temperatures, except as noted)

No.	Crystal	T_c	P_s	E_c	Crystal symmetry: Para	Ferro	Polar axis	Reference
1	GASH	..	0·35*	1·5*	..	P3lm	[001]	7
2	MASD	− 96	1·02	12·0	$P2_13$	$P2_1$	[100]	8
3	$(NH_4)_2SO_4$ ..	− 49·5	0·47	4·0	Pnam	$Pna2_1$	[001]	9
4	$(NH_4)_2BeF_4$ ..	− 97	0·16	1·4	Pnam	$Pn2_1a$	[010]	10
5	NH_4HSO_4 ..	− 3	0·38	0·15	$P2_1/c$	Pc	[001]	11
6	$RbHSO_4$ ..	− 15	0·30	0·4	$P2_1/c$	Pc	[001]	12
7	$Na(NH_4)SO_4 \cdot 2H_2O$ ..	−171	0·53	5·0	$P2_12_12_1$	$P2_1$ or Pl	[001]	13
8	$(NH_4)_2Cd_2(SO_4)_3$ ..	−178	0·50	25·0	$P2_13$	$P2_1$ or Pl	[100]	14
9	$Li(N_2H_5)SO_4$ ..	..	0·30*	0·3*	..	$Pon2_1$	[001]	15
10	$(Glycine)_3 \cdot H_2SO_4$ ..	47	2·2*	0·22*	$P2_1/m$	$P2_1$	[010]	16
11	$(Glycine)_3 \cdot H_2SeO_4$ ..	22	3·2	0·78	$P2_1/m$	$P2_1$	[010]	16
12	$(Glycine)_3 \cdot H_2BeF_4$ ..	70	2·2	5·0	$P2_1/m$	$P2_1$	[010]	17
13	$(Glycine) \cdot AgNO_3$ ..	− 55	0·21	0·28	$P2_1/m$	$P2_1$	[010]	18
14	$(Glycine) \cdot (Ag_{0\cdot82}Tl_{0\cdot18})NO_3$ ..	− 38	0·17	0·70	$P2_1/m$	$P2_1$	[010]	19
15	$(Glycine) \cdot (Ag_{0\cdot82}Li_{0\cdot18})NO_3$ ..	− 38	0·20	1·0	$P2_1/m$	$P2_1$	[010]	19
16	$(Glycine)_2 \cdot HNO_3$ ..	− 67	0·60	0·40	$P2_1/a$	Pa	[101]	19
17	$(Glycine)_2 \cdot MnCl_2 \cdot 2H_2O$ ..	..	1·3*	5·6*	..	$P2_1$	[010]	20
18	$CH_2ClCOONH_4$ ..	−156	0·12	0·40	C2/c	Cc or Pc or Pl	[101]	20, 21
19	$Ca_2Sr(C_2H_5COO)_6$ ..	8	0·12	3·2	$P4_12_12$	$P4_1$?	[001]	22
20	$K_4Fe(CN)_6 \cdot 3H_2O$ ..	− 22	0·21	8·0	C2/c	Cc?	[101] or $[\bar{1}01]$	23
21	NH_2CSNH_2 ..	−105	3·1	1·0	Pbnm	?	[010]	24
22	$LiH_3(SeO_3)_2$ ..	..	15·0*	1·4*	..	Pn	⊥ to (001)	25
23	$NaH_3(SeO_3)_2$ ..	− 79	4·2	3·6	$P2_1/n$	Cl	[313]	26
24	KNO_3 ..	124	8·0	..	R3c	R3m	[001]	27
25	$NaNO_2$ ..	160	6·4	2·3	Immm	Imm2	[001]	28

* At room temperature.

field, etc. The recent studies[29] on the switching characteristics of this crystal also seems to be encouraging for possible use of this crystal in memory devices. However, the very recently discovered[25] room-temperature ferroelectric $LiH_3(SeO_3)_2$ appears to have even more favourable properties than $(glycine)_3.H_2SO_4$. $LiH_3(SeO_3)_2$ exhibits useful ferroelectric properties in the entire temperature range − 196° C. to 90° C. and further possesses the largest spontaneous polarization of 15 μcoul./cm.^{2} observed for a water-soluble crystal. The coercive field also is not very high. Results on the switching characteristics of this crystal are eagerly awaited.

It is a bit too early to postulate on the mechanism of the ferroelectric transition in the various crystals listed in Table I; for, before one can develop such model theories, the exact structural details both above and below the transition temperatures of these crystals should be available. Such crystal structural analyses both by the X-ray and neutron diffraction techniques are in progress at Prof. Pepinsky's Laboratory and elsewhere. Incidentally it may be pointed out that of all the ferroelectric crystals known up to this time we seem to understand the mechanism of the transition only in the case of KH_2PO_4.

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HARWELL EXPERIMENT TO MEASURE THE GRAVITATIONAL RED SHIFT

ONE of the results which follows from Einstein's general theory of relativity concerns the frequency of emission of light—or other electromagnetic radiations—by atoms situated in different gravitational fields. According to the theory a characteristic radiation involving two atomic energy states should have a lower frequency when the radiating atom is, for example, on the sun than when it is on the earth. It may be looked upon that the radiated photon ($h\nu$), in escaping from the greater gravitational forces of the sun, loses more energy than it does on the earth, where the gravitational force is comparatively weak, and thus appears to have a lower frequency or a longer wavelength. This gravitational red shift amounts to $\Delta\lambda/\lambda = 2{\cdot}12 \times 10^{-6}$ for the sun, where the gravity is 27·6 times as great as it is on the earth. For the dense white star, the companion of Sirius, the shift is about 30 times as great.

The difficulties involved in the astronomical methods of testing the predictions of the theory are well known. During the last two years methods have been devised to test the theory by "red shift" experiments carried out on the earth itself, say, between two fixed points at different gravitational potential. In such a trial it is obvious that because of the extremely small magnitude of the shift, nothing but an experiment of extraordinary precision and sensitivity may be expected to yield any fruitful result. The ingenious method suggested by Pound and Rebka of Harvard University is based on the recently discovered Mössbauer effect concerning the resonance absorption of gamma rays by atomic nuclei (see p. 85). As pointed out in that article any characteristic gamma radiation from a radioactive nucleus does not emerge with the indefinitely precise frequency, determined by the two discrete energy states, but for reasons connected with the nature of the nucleus, the radiation is rather spread over a range of frequencies, thus giving the gamma line a certain spectral width. One of the chief reasons for this 'smearing' of frequency is the recoil of the emitting nuclei. Mössbauer has shown that in crystalline solids there is a finite probability for the gamma rays to transfer momentum to all the nuclei of the crystal as a coherent whole instead of to the individual nucleus. In other words since the recoiling mass has considerably increased, the velocity of recoil, and hence the energy loss from the photons, is also correspondingly reduced. Thus such photons will emerge with practically no change in frequency. If now these gamma rays are made to pass through a

second crystal of the same material they will be absorbed due to the nuclear resonance phenomenon. It has been shown that the condition for the resonance absorption is so critical that even an extremely small change in energy, as for example by the movement of the source towards or away from the absorber, destroys the resonance absorption.*

Experiments to detect the red shift, based on the above principle, have been undertaken at Harwell, at Harvard and also in the Manchester University. The principle of the Harwell experiment is to compare the frequency of the gamma rays emitted by the radioactive iron isotope Fe^{57} at a certain height above the ground, with the same frequency at ground level. Because of the difference of height, and therefore of gravitational energy, atoms above the ground ought to emit at a higher frequency than those on the ground. Though the amount of red shift is proportional to the difference in height between the two sources, calculations show that the accuracy with which the red shift can be measured in the Harwell experiment is more or less independent of the distance. So a length of vertical and evacuated water pipe 12·5 metres long and 15 cm. in diameter is mounted inside a water-tower at Harwell, and the comparison of frequencies is carried out in that.

The gamma ray source Fe^{57}, which is itself produced by the radioactive decay of Co^{57}, is placed at the top end of the water pipe. At the bottom of the pipe is a thin foil of the same material which acts as the absorber. Radiation not absorbed is transmitted through and is detected by means of suitable amplifiers and recording device.

If there be no gravitational effect on the radiation, the frequency (as well as its range width) from the emitting nuclei being exactly identical with that of the absorbing nuclei, there will be, theoretically speaking, complete absorption and the detector will indicate no transmission energy. Due to the gravitational red shift, however, the gamma line from the source will be shifted bodily to a slightly higher frequency and only the overlapping range of frequencies in their "natural widths" will be absorbed. There would thus be a small range which would not in any circumstances be absorbed in the iron (Fe^{57}) foil at the bottom.

To make measurements possible the source at the top is made to vibrate through a small distance 50 times a second, so that during half of each vibration the red shift is cancelled out by the source's Doppler speed. There will be an asymmetry in the transmission and by comparing the transmission through the foil every hundredth of a second, the transmission thus modulated can be amplified and it will be possible to detect the asymmetry due to the gravitational red shift.

*Pound and Rebka have shown that the movement of the Fe^{57} source at the rate of 0·017 cm./s. reduces the absorption by a half. In the familiar analogy of the Doppler effect in sound, this is equivalent to detecting the frequency change of the whistle of a railway engine moving at the rate of one-eighth of an inch per year!

SYMPOSIUM ON SOLID STATE PHYSICS AND THE CONFERENCE OF THE PHYSICAL RESEARCH COMMITTEE (C.S.I.R.)

A SYMPOSIUM on Solid State Physics was organized by the Physics Department, Indian Institute of Science, Bangalore, during the Golden Jubilee year to take place along with the annual Conference of the Physical Research Committee of the Council of Scientific and Industrial Research. They were held on February 1-3, 1960, and were attended by over 130 delegates from the different laboratories of India. More than 100 papers were presented. Dr. S. Bhagavantam, Director, Indian Institute of Science, inaugurated the Conference. This was followed by a lecture on "Geomagnetism of the Upper Atmosphere" by Prof. K. R. Ramanathan, of the Physical Research Laboratory, Ahmedabad.

The technical sessions on the opening day were devoted to the Spectroscopic study of solids, Neutron scattering and the structure of the solid state, and Defects in solids. Prof. R. S. Krishnan (Bangalore) gave an account of the important results obtained during the past few years in the Physics Department of the Institute by the use of the Rasetti technique in regard to the Raman spectra of crystals and Brillouin scattering. A noteworthy feature of this resume was the verification of the recent measurements of the photoelastic constants of diamond by Poindexter from Brillouin scattering studies. Prof. R. S. Krishnan's talk was followed by presentation of papers on Raman Effect, Infra-Red Spectra and Microwave Spectra. In the

afternoon session Dr. R. Ramanna (Bombay) gave a brief survey of the technique of neutron diffraction and their applications to the study of solid and liquid states. Neutron diffraction in vanadium and germanium and the information obtained therefrom regarding the vibrations and thermodynamic properties of a harmonic crystal were presented by Dr. P. K. Iyengar (Bombay). Prof. W. Koch (Madras) spoke on the structure of metal semiconductor contacts. Dr. K. Vedam reviewed the current developments in the field of Ferroelectricity and the properties of newly developed ferroelectric crystals.

The second day of the symposium commenced with an address by Dr. S. Bhagavantam on "Non-linear Elasticity" in the course of which he sought to explain several geophysical features of great practical importance, on the basis of the theory of finite deformation elasticity. In the session devoted to Magnetic Resonance Phenomena, Drs. S. S. Dharmatti and B. Venkataraman presented the work on NMR and EPR which were being pursued at T.I.F.R. and A.E.E.T., Bombay. A group of young workers from the Nuclear Physics Institute, Calcutta, discussed some theoretical aspects of atomic and nuclear magnetic problems.

The third day of the Conference opened with a talk on the "Fourier and Vector Shift Methods in X-ray Crystal Structure Analysis" by Prof. G. N. Ramachandran (Madras). Dr. S. Ramaseshan (Bangalore) presented an account of the results on organic and inorganic structures under investigation at the Institute, their importance from the point of view of valency, chemical binding and steric hindrance, and also of techniques developed in the laboratory for low temperature crystallography. This was followed by papers on structure problems, study of crystallinity and orientation of crystallites in fibres, thermodynamics of structural changes, etc. The last session of the Conference was devoted to papers on geophysics, oceanography, micrometeorology and micro-seismology.

Dr. Vikram Sarabhai, Chairman of the Physical Research Committee, in his concluding remarks expressed the hope that a symposium of this kind would become an annual feature and lead to a better understanding and coordination of research in Solid State Physics in India. The full proceedings of the Conference are expected to be published shortly.

DIFFERENCE METHOD FOR RAMAN SPECTRA INVESTIGATIONS

DIFFERENCE methods although widely employed in Infra-red spectroscopy have not so far been used in the study of Raman spectra. The successful application of this method and its possibilities to molecular analysis by Raman spectra are indicated by Zubov *et al.*, in a note in *Optics and Spectroscopy*, June 1959, p. 541.

A grating spectrograph with photoelectric accessories (consisting of photomultiplier tube FEU-17, preamplifier, selective amplifier and recorder) for the registration of spectra is used in the investigation.

In the difference method light is directed on to the entrance slit of the spectrograph alternately from two sources by means of a rotating mirror. The light energy after dispersion is received on the photomultiplier placed immediately after the exit slit. When the two light beams are equal in intensity the resulting photocurrent in the multiplier tube is unmodulated and is not passed by the selective amplifier which is tuned to the modulation frequency. When one light beam has a higher intensity, the resulting photocurrent contains an alternating component which is amplified and activates the recorder. In this way the difference of the signals is recorded.

In the application of the method to Raman spectra investigations, the two sources are the two Raman tubes, one of which will give the full spectrum under investigation and the other will give the spectrum which it is desired to be "subtracted".

The following possible uses of the difference method in Raman investigations might be indicated: (1) Elimination of background interference in the region close to the exciting line. In this case the Rayleigh line of a substance with a structure similar to that of the scattering substance is "subtracted" from the Raman spectrum of the latter. This permits, for example, the study of low frequency lines which are difficult to investigate by other methods. (2) The investigation of mixtures in which Raman lines of interest in analytical work are covered up by lines of another component of the mixture. Here the spectrum of the interfering component with matching intensity is "subtracted" from the spectrum of the mixture. (3) The study of small changes in the width and in the intensity of lines in the investigation of solvent influence and temperature effects

THE MÖSSBAUER EFFECT

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THE discovery that parity is not conserved in weak interactions brought about a renaissance in low-energy nuclear physics. A second renaissance, although of a less pronounced nature, can be said to have come about with the discovery of the Mössbauer effect. This concerns the absorption of gamma-rays. Nuclear resonance absorption is a well-understood phenomenon. When an excited nucleus emits a gamma-ray, the emitting nucleus suffers a recoil and if there is an absorber placed to absorb this gamma-ray the absorbing nucleus also recoils; hence the resonance condition is lost and no resonance absorption occurs, unless the recoil energy is restored. There are essentially three methods for compensation of the recoil energy loss: (1) Doppler shift by means of mechanical motion with the help of an ultra-centrifuge; (2) Doppler broadening of emission and absorption lines through increase of temperature to improve the overlap of the two lines and (3) Doppler broadening of quantum energies through a preceding emission and absorption process, for instance, a gamma transition preceded by a beta-transition or electron-capture. When the energy of the gamma-ray is sufficiently high, it will be reasonable to assume the emitting and absorbing nuclei to be both free. The question then arises as to what happens when the gamma-ray energy is small, say, less than 200 kev. and the nuclei are not free to recoil. Mössbauer[1,2] discovered that at low temperatures an increased nuclear absorption occurred in the case of 129 kev. gamma-ray in Ir-191 indicating a strong dependence on crystal binding. Now the emission or absorption of a quantum by a nucleus bound to a crystal lattice ordinarily leads to a change in vibrational state of the crystal lattice, which takes up the recoil momentum. With a decrease in temperature the probability for excitation of the inner levels decreases so that in the case of soft gamma-rays and hence recoil-energy being small, the crystal as a whole takes up the recoil momentum. The emitted and absorbed quanta thus suffer practically no recoil energy loss because of the heavy mass of the crystal and thus the resonance condition is fulfilled. If the width of the gamma-ray emitting state is known, one can obtain the lifetime of the level using the uncertainty relation. The factors favouring the Mössbauer effect are, first low-energy gamma-ray (< 200 kev.) and secondly, low temperature and a high Debye temperature. A specially interesting case for the observation of the Mössbauer effect is provided by Fe-57 which has a high Debye temperature (450° K.) and has an excited state at 14 kev. whose lifetime is 10^{-7} sec. This 14 kev. level is excited in the decay of 270-day Co-57. In this case the ratio of the level width to the energy of the level is 10^{-13}. Thus this gives rise to the possibility of detecting a frequency change of 1 part in 10^{13}. Fe-57 has the additional advantage of being ferromagnetic with an internal magnetic field of 200 kilogauss. Thus one would expect to observe nuclear Zeeman effect since the ground state spin of Fe-57 is ½ and that of the 14 kev. level is 3/2. This has been recently observed by the Argonne groups who have obtained values for the magnetic moments.

The discovery of the Mössbauer effect has opened up new possibilities. For one thing, it provides a tool for understanding the solid state. The most significant consequence is that it has given a means of detecting very small changes in frequency such as are predicted by the theory of relativity. Experiments to measure the gravitational red shift are already under way at Harwell and Harvard and it is with great interest that one looks forward to their completion.

[Results of the first experiments on the gravitational red shift at Harwell, using the Mössbauer recoilless nuclear resonance absorption of gamma-rays in Fe-57, are published in two communications in *Physical Review Letters*, February 15, 1960, Vol. 4, No. 4, pp. 163 and 165. In the first letter by Cranshaw, Schiffer and Whitehead, it is noted that the *observed* shift in the ratio of the counting rates (according to the experimental set up) was $3{\cdot}75 \times 10^{-4}$, with an uncertainty of $1{\cdot}76 \times 10^{-4}$, as against the *expected* shift of $3{\cdot}9 \times 10^{-4}$. This gives a positive confirmation of the gravitational red shift. In the second note by Hay Schiffer, Cranshaw and Egelstaff on "the red shift in an accelerated system", it is shown that the size of the observed shift of the gamma-ray energy in the effective gravitational field of a rotating system is in agreement with that due to the terrestrial gravitational field, within the accuracy of measurements.—*Editor.*]

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2. —, *Naturwiss.*, 1958, **45**, 538.

MANGANESE AND LATHYRISM

T. S. SADASIVAN*, C. B. SULOCHANA*, V. T. JOHN*, M. R. SUBBARAM‡ AND C. GOPALAN‡

INCIDENCE of lathyrism, associated with the consumption of seeds of *Lathyrus sativus* L. has been recorded in many countries like India,[1] Spain[2] and Syria.[3] The actual toxic factor(s) in *L. sativus* responsible for the disease has yet to be elucidated. In India the incidence of lathyrism in parts of Madhya Pradesh, Bihar and Uttar Pradesh has been high in recent years. High selenium content in the seeds of *L. sativus* was incriminated as being responsible for the disease.[4] This finding was however not corroborated by later investigators.[5]

In a comprehensive analysis of *L. sativus* seeds for various minerals in the University Botany Laboratory, Madras, emission spectra of many seed sample of the 1958 crop of *L. sativus* indicated bold lines of Mn but not Se (Fig. 1). Subsequently more seed samples were analysed for Mn by absorption spectrometry (Table I).

The high content of Mn revealed by the spectrographic analysis was confirmed by chemical estimation using the Periodate method.[6]

TABLE I

Manganese in Lathyrus sativus *seeds*

Year of cropping	Mn in mg.% (dry weight basis)			
	Normal range	No. of samples	Abnormal range	No. of samples
1956	1·8–2·5	6	5·9	1
1957	1·8 3·0	8	..	..
1958	1·2–3·1	44	5·0–50·0	8
1959	1·5–2·0	75	5·3	1

TABLE II

Manganese in testa and cotyledons of L. sativus *seeds*

Sample No.	Mn in mg.% (dry weight basis)	
	Testa	Cotyledons
6	4·5	2·2
11	7·0	1·7
12	9·8	2·0
50	4·0	1·4
52	4·0	1·5
76	7·5	1·9
142	14·7	3·0

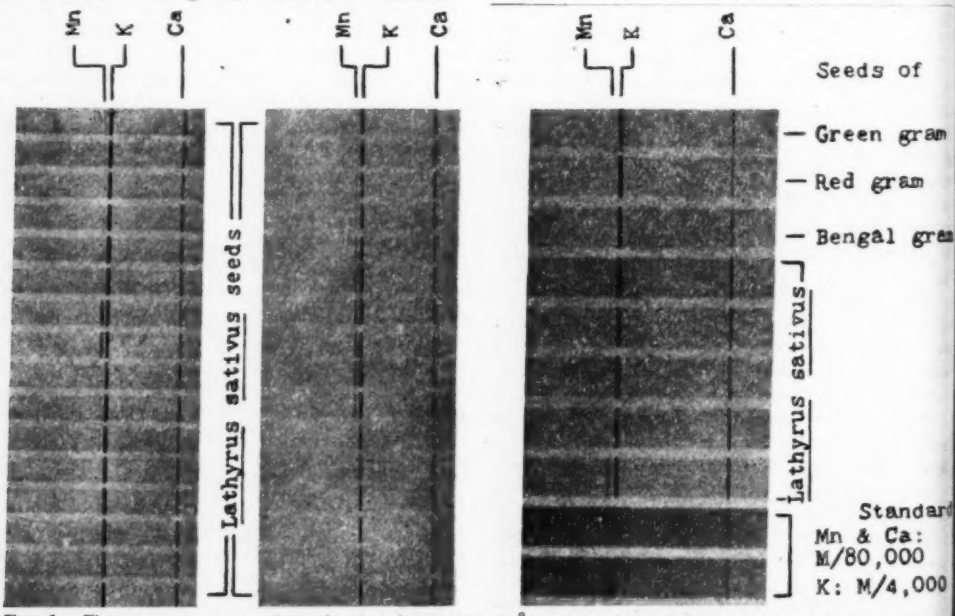

FIG. 1. Flame spectrograms of Mn (4000·7 Å), K (4044·1 Å) and Ca (4226·7 Å) in seeds of *Lathyrus sativus* and other pulses. Note high Mn in several samples of *L. sativus* as shown by Mn lines of high density, whereas other pulses show negligible Mn lines under comparable analytical conditions (Medium quartz spectrograph was used).

* University Botany Laboratory, Madras-5.
‡ Nutrition Research Laboratories, Hydebrabad-7, Andhra Pradesh.

Analysis of a large series of samples of *L. sativus* carried out in the Nutrition Research Laboratories using the chemical method also revealed a high content of Mn in some samples. In con-

trast to these high figures in *L. sativus* seeds analysis of seeds of cereals and other legumes from the same endemic area revealed low Mn content.

Testa (husk) of seeds showed on analysis much higher Mn content than cotyledons (Table II).

Analysis of *L. sativus* field soils from the endemic areas of Bihar, Madhya Pradesh and Uttar Pradesh showed a high Mn content as compared with the soils of Madras (Table III).

TABLE III
Range of Mn in L. sativus *field soils*

Soil samples from	Mn in mg. %	
	Total Mn	Plant available Mn
Madhya Pradesh	39·5-67·5	13·7-32·5
Uttar Pradesh	15·0-39·0	6·5-13·7
Bihar	39·5-86·0	15·3-44·5
Madras	19·0-26·0	..

Preferential uptake of Mn in significantly high amounts appears characteristic of only *L. sativus* plants among those included in our analyses and even that only in certain years. For instance, the 1958 crop showed a high Mn in seed samples from several areas in Rewa District and the 1959 samples had uniformly low Mn content. As heavy rainfall in the area was registered in 1959, the question of Mn uptake being conditioned by soil moisture was explored. Controlled experiments showed a positive correlation between soil moisture and Mn uptake, the optimum being 20 to 40% moisture-holding capacity. In fact, at higher moisture levels Mn accumulation was almost half that at 40% level. An examination of the meteorological data for the years 1922 and 1945 recorded,[1,7] showed that the epidemics in both instances followed years of negligibly low rainfall during the winter crop season. This observation, however, could also mean that in years of drought and consequent failure of other staple crop, villagers consumed more *L. sativus* than usual and for longer periods.

A high content of Mn in *L. sativus* samples had been reported from Spain, a finding which came to our notice later. In this Spanish report[8] Mn values of the order of 118 to 225 p.p.m. were recorded.

The significance of the high Mn content observed in some *L. sativus* samples required further elucidation through field studies and actual clinical investigation of patients. The clinical features of manganese intoxication in human subjects are akin to Parkinsonism and are thus different from the clinical picture of lathyrism. However, Mn may either be indicative or may potentiate the action of some factor in the *L. sativus* seeds responsible for the disease. In fact, Mn compounds as they occur in green leaves and seeds of mature plants have been shown to be much more active biologically than equal portions of a crystalline salt of Mn in synthetic diet.[9,10] On the other hand the occurrence of high Mn content in certain samples of *L. sativus* may be unrelated to the development of the disease. These possibilities have to be explored in future investigations. Such clinical and field investigations have been initiated in the Field Unit at Rewa.

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INDIAN SCIENCE CONGRESS

THE 47th Session of the Indian Science Congress was held in Bombay under the auspices of the Bombay University from January 3-9, 1960. The session was inaugurated by Prime Minister Jawaharlal Nehru. Mr. Sri Prakasa, the Governor of Bombay and Chancellor of the Bombay University welcomed the gathering which included about 70 foreign scientists.

Prof. P. Parija, Vice-chancellor of the Utkal University presided over the session and delivered the Presidential Address on "Impact of Society on Science".

Besides the reading of papers in the different sections, presided over by the respective sectional Presidents, there were arranged a number of symposia and a series of popular lectures. One of the series was on "Atoms and Human Knowledge" by Prof. Niels Bohr.

The 48th Session of the Congress will be held at Roorkee from January 3-9, 1961, under the Presidentship of Dr. N. R. Dhar. Dr. B. Mukerji, Director, Central Drug Research Institute, Lucknow, has been elected General President for 1961-62.

MODERN FISHING GEAR OF THE WORLD*

FISHING is one of the earliest occupations of man in the field of food production, but it is not generally known how complex is the practice of modern fishing. In 1957, the FAO organised a Fishing Gear Congress which was held at Hamburg. This was an important step forward in the development of commercial fishing and the present book is the edited version of the large number of technical papers presented and discussed at this Congress.

Following an introduction by the Director of the Fisheries Division of the FAO and a note on modern trends in fishing by the Editor of this volume, over 100 technical papers are grouped under the headings: material, terminology and numbering systems; characteristics of fishing twines and their testing; net making; net preservation; relative efficiency of nets made of different materials; engineering theory and model testing; use of measuring instruments and underwater observations; methods of specifying gear; fishing gear and its operation; location of fish; detection of fish; attraction of fish; and, electrical fishing. These papers cover the wide range of technical improvements which have been effected in fishing gear, gear materials and techniques of fishing. The most important advances in the field of fishing have been summarised by the Editor in his introduction as (*a*) mechanisation of fishing; (*b*) the application of echo-sounding techniques; and (*c*) the advent of synthetic fibres for fishing nets. It is indicated that the fourth more important stride which is to take place is the application of engineering theory and rational methods to the development of fishing gear and their operation.

A perusal of the papers presented would indicate the correctness of highlighting the above three as the most significant advances which have taken place in recent years. The advent of steam-power and later the diesel which began at the beginning of this century, and which have been gaining ground in all countries, is the one significant factor which has contributed to the enlargement of the area and seasons for fishing. It is possible to recognise two distinct phases in this because there is, first of all, the mechanisation of the craft alone as is now largely taking place in India in the Bombay-Saurashtra area and, secondly, the utilisation of mechanical power for the handling of nets. The rapid strides in underwater instrumentation which took place during the Second World War gave great stimulus to the use of echo-sounding and fish finding equipment in fishing vessels and, in fact, has made fishing more exact and certain of success in many commercially well-known fishing grounds. The old system of shooting the net and leaving the rest to chance is no longer in vogue and in years to come will certainly be ranked as wasteful.

Man-made fibres of various kinds beginning with nylon are slowly replacing the old types of fishing twines made of cotton and hemp and their relative efficiency is so pronounced that synthetic fibres have secured an assured place in fishing. Even with the frail catamarans operating on the East Coast of India, it is not unusual to find the fishermen's catches increased 5 to 10 times when the cotton nets are replaced with nylon nets. It is only by a large combination of factors leading to improved gear and better methods of operations could, however, the disparity in *per capita* production of fish per fisherman from about one ton per head per annum in the underdeveloped countries to about 80 tons per annum in the most advanced fishing countries could be achieved. Such improvement in efficiency will take many years of long and arduous work to accomplish but without substantial increase in *per capita* output, the fishing industry of most countries would not be able to thrive and develop.

And such a rapid increase in production through more efficient techniques is of the greatest importance to countries deficit in protein foods where, apart from contributing a large supply in terms of weight, fish products offer the most easy and practicable means of correcting nutritional imbalance. Fish production has increased during the last few years from 25 million Metric tons to nearly 30 million Metric tons in 1957 and it is hoped that the combined efforts in the numerous fields of fisheries will make it possible to increase the world fish production to some 60 million tons a year.

Students of fisheries science will find this volume a mine of information relating to fishing gear and the book will serve as a valuable work of reference for many years to come.

N. K. PANIKKAR.

* Edited by Hilmar Kristjonsson. Issued by FAO of the United Nations. Published by Fishing News (Books) Ltd., Ludgate House, 110 Fleet Street, London. 1959. Pp. i-xxxi+607. Text Illustrations.

LETTERS TO THE EDITOR

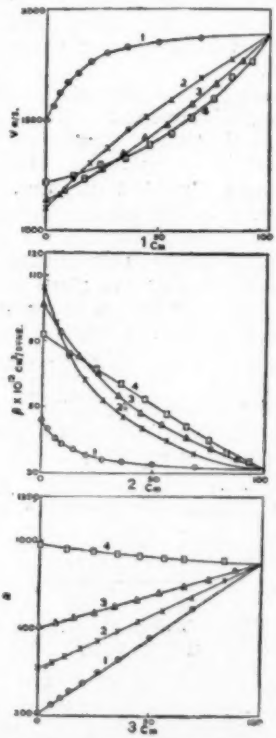
ULTRASONIC STUDIES IN GLYCEROL-ALCOHOL MIXTURES

NOMOTO[1] reviewed the available data on liquid mixtures and showed that even though properties like ultrasonic velocity and adiabatic compressibility show deviations from the ideal linear behaviour, the molar sound velocity and the molar compressibility vary linearly with molar concentration. In the present investigation the variation of ultrasonic velocity in (1) Glycerol-Water; (2) Glycerol-Methyl alcohol; (3) Glycerol-Ethyl alcohol and (4) Glycerol-n-butyl alcohol is measured with a view to study the nature of variation of adiabatic compressibility and molar sound velocity with concentration. The ultrasonic velocity is determined up to an accuracy of 0·1% by using the interferometer method.[2]

Figures 1, 2 and 3 represent the nature of variation of ultrasonic velocity (V), adiabatic compressibility (β) and molar sound velocity (R) respectively, with molar concentration for all the liquid mixtures investigated. All these measurements were made at room temperature 30° C.

All the four mixtures have a common constituent glycerol which is a highly associated liquid. The other component liquids are also of the same type due to the presence of active (OH) dipoles. For the first mixture it will be seen from Fig. 1, that the velocity of the mixtures rises very rapidly with the addition of glycerol at lower concentrations and slowly above 50% concentration. This rapid rise of velocity is attributed to the breaking up of molecular associations of the two component liquids. The compressibility curve in Fig. 2 shows the exact opposite behaviour in that the adiabatic compressibility first falls off very rapidly at lower concentrations of glycerol and then slowly at higher concentrations. Here glycerol is a liquid containing (OH) groups and the interaction of the glycerol molecules with water molecules is greater than the interaction among themselves. This results in breaking up of associations of water molecules when the cohesive energies locked up in different associations will be released. As the molecules all round will now knit up more closely due to freed dipoles, the cohesive energy increases thereby decreasing the compressibility. Thus this effect results in a rapid decrease of adiabatic compressibility at lower concentrations of glycerol. After the process of breaking up of associations ceases the compressibility falls less rapidly reaching finally the value of glycerol. It is interesting to note that the variation of molar sound velocity R, shown in Fig. 3, is perfectly linear as expected in spite of the peculiar nature of variation of velocity and adiabatic compressibility.

In the next mixture glycerol-methyl alcohol the deviation of velocity variation from linear law is less as can be seen from Fig. 1. The



FIGS. 1-3. Fig. 1. Variation of ultrasonic velocity (V) in (1) glycerol-water, (2) glycerol-methyl alcohol, (3) glycerol-ethyl alcohol and (4) glycerol-n-butyl alcohol mixtures with molar concentration C_m of glycerol. Fig. 2. Variation of adiabatic compressibility β in (1) glycerol-water, (2) glycerol-methyl alcohol, (3) glycerol-ethyl alcohol and (4) glycerol-n-butyl alcohol mixtures with molar concentration C_m of glycerol. Fig. 3. Variation of molar sound velocity R in (1) glycerol water, (2) glycerol-methyl alcohol, (3) glycerol-ethyl alcohol and (4) glycerol-n-butyl alcohol mixtures with molar concentration C_m of glycerol.

compressibility concentration curve is less steep than in the previous case. Again the variation of molar sound velocity is found to be linear as can be seen from Fig. 3. The data for glycerol and ethyl alcohol mixture do not show any prominent deviation from ideal linear behaviour. The velocity *versus* concentration curve falls slightly below the ideal linear variation curve unlike the two previous cases. The compressibility variation is less non-linear than those for the two previous mixtures. In the case of glycerol and *n*-butyl alcohol mixtures, though the velocity *versus* concentration is more curved towards the same side as the third mixture, the compressibility curve is nearly linear. The molar sound velocity concentration curve on the other hand shows a slight deviation from linearity as can be seen from Fig. 3.

An interesting feature that can be generalised for these four mixtures is that the large curvature of the compressibility concentration curve for glycerol-water mixture progressively decreases until the last mixture. Similar general change in the shape of the curve is noticed for the velocity-concentration graph. An important conclusion from this is that water has the maximum effect on the glycerol molecules and that the breaking up of associations is maximum for this case. For methyl alcohol and other higher alcohols the effect progressively decreases.

Ultrasonic Labs., K. SUBBA RAO.
Andhra University, B. RAMACHANDRA RAO.
Waltair, December 31, 1959.

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CHLORINE FILLED OZONISER AS A COUNTER

KORFF[1] has shown that the halogens are undesirable in counters because of the high electron attachment probability. The production of negative ions in self-quenching G.M. Counters causes spurious counts or an excessive number of closed doubles or multiples. Although early counter production was entirely confined to the use of organic quenching techniques, the development of G.M. tubes using the halogens has been started in 1949, and a well-established range of types to meet most requirements have now been evolved.[2] The chief advantages of halogen-quenched counters over the organically quenched ones are (*i*) their electrical robustness; (*ii*) stable tube characteristics; (*iii*) infinitely longer life; (*iv*) low operating potentials and (*v*) a small temperature coefficient.

The use of halogens as quenching agents poses special problems and limitations in the choice of electrode materials to the tube designers. In our laboratories we have used an all-glass chlorine-filled Siemen's Ozoniser as a counter. The tube is preferred for a number of reasons. The absence of metallic electrodes is a great advantage. There is no sputtering under discharge. The excited media do not readily combine with the electrodes. The disappearance of a gas or adsorption effects, due to the presence of metallic electrodes, do not complicate the data on the electrical discharge. The tube is favoured also on account of the considerable ease in obtaining the electrode surface free from impurities and adsorbed gases by the well-known process of drying, washing and degassing under vacuum.[3] A typical set of data on the characteristic curve of a chlorine-filled ozoniser as a counter detecting the cosmic ray particles is reproduced below (Fig. 1). The

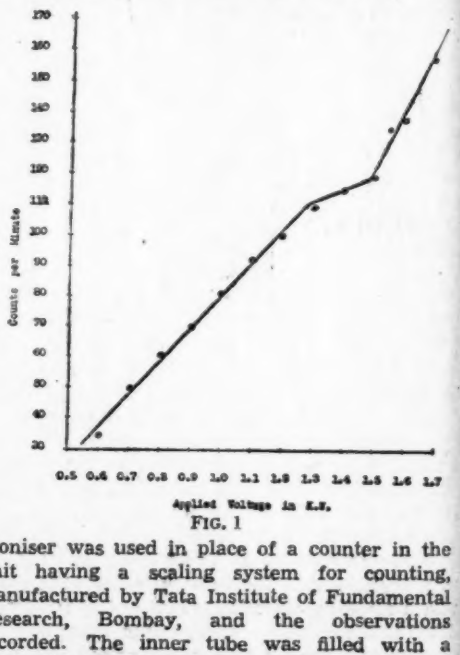

FIG. 1

ozoniser was used in place of a counter in the unit having a scaling system for counting, manufactured by Tata Institute of Fundamental Research, Bombay, and the observations recorded. The inner tube was filled with a conducting solution and the ozoniser was also immersed partly in a conducting solution. The d.c. voltage to the ozoniser was applied as

usual through electrodes placed in the solutions. A part of the total d.c. voltage was acting against the gas phase.

The dimensions of the ozoniser are : Length—125 mm. Internal diameter of the outer cylinder—14·15 mm. External diameter of the inner cylinder—8·75 mm. Pressure of chlorine gas—12 mm. of mercury at 38° C.

The details of the work will be published elsewhere.

Department of Physics, M.L.B. College, Gwalior, *November* 15, 1959.

R. G. ANIKHINDI.
A. P. SAXENA.

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PHOTOSENSITIZED POLYMERISATION BY URANYL IONS

THE photosensitizing action of uranyl ions has been the subject of considerable research especially in the oxidation of organic substrates like oxalic acid,[1] lactic acid,[2] methyl alcohol,[3] sucrose,[4] etc. Uranyl ions have also been used to photosensitize the polymerisation non-ideal vinyl monomer methacrylic acid,[5] but no detailed mechanism has been put forward for the latter reaction.

Uranyl ion photosensitized polymerisation of ideal vinyl monomers methylmethacrylate, acrylonitrile and methylacrylate in aqueous solution has been carried out by us. Monochromatic light of wavelengths 365 mμ, 313 mμ, 405 mμ and 435 mμ, have been employed for the purpose. Uranyl perchlorate in perchloric acid has been used as source of uranyl ions. Adjustment of pH, etc., have been done with A. R. perchloric acid. Ordinary distilled water twice distilled over alkaline permanganate in an all-glass still and then freed from carbon dioxide has been used for making up of the solutions.

It has been found that under controlled conditions of acidity (pH, 0 to 1·5) and ionic strength (0·5) which exclude any complex or ion-pair formation, the rate of polymerisation is directly proportional to the square-root of the incident light intensity (I), uranyl ion concentration $[UO_2^{++}]$ and square-root of the light absorption fraction K_ε, and also to 3/2 power of the initial monomer concentration [M] (Fig. 1 A).

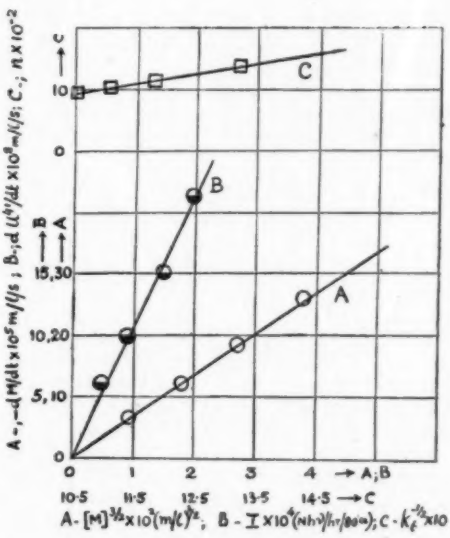

FIG. 1

It has been observed that the U^{6+}, i.e., UO_2^{++} ion suffers photo-reduction to U^{4+} state during the course of the reaction, and that the extent of this reduction $-dU^{6+}/dt$ or dU^{4+}/dt is directly proportional to K_ε, I (Fig. 1 B) and [M].

The viscometric chain lengths '*n*' of the polymers formed have been found to be proportional to $I^{-\frac{1}{2}}$, $K_\varepsilon^{-\frac{1}{2}}$, (Fig. 1 C) and $[M]^{\frac{1}{2}}$. All the three factors, $-dM/dt$, dU^{4+}/dt and '*n*' have been found to be independent of pH as well as ionic strength of the medium.

The effect of added uranous ions appears to retard the rate of polymerisation. An optimum concentration of $[U^{4+}] \leq 1/5\ [UO_2^{++}]$ has been observed to give rise to a net increase in total $[UO_2^{++}]$ in the system.

The reaction has been found to proceed by a free radical mechanism. A tentative mechanism based on electron transfer from vinyl monomer to excited uranyl ion resulting in a radical ion and pentavalent uranium has been postulated. The reactions that are likely to occur and which conform to our experimental results are given below.

$$[UO_2^{++}] \xrightarrow{h\nu - K_\varepsilon I} [UO_2^{++}]^* \qquad (k_f \text{ reverse})$$

$$M + [UO_2^{++}]^* \xrightarrow{k_r} UO_2^{+} + X$$

(Monomer)

where X is $H_2\overset{+}{C}-CH-X$

$$X + M \xrightarrow{k_p} X-M$$

$$X-M_n + X-M_m \xrightarrow{k_t} X-M_{m+n}-X$$

or

$$X-M_n-X + X-M_m=CH_2$$

$$2UO_2^{++} + H^+ \xrightarrow{k_d} UO_2^{++} + UOOH^+$$

The constancy of the intensity exponent at 0·5 shows that the interaction of two growing chains is the predominant chain termination reaction. The quantum yields for uranous ion formation have been calculated and the values range from C 25-0·50. Also the parameter $k_p/k_t^{\frac{1}{2}}$ is of the order of $\simeq 0{\cdot}3$ for methylmethacrylate, $\simeq 0{\cdot}41$ for methylacrylate and $\simeq 0{\cdot}07$ for acrylonitrile. The value of k_t/k_r is $\simeq 0{\cdot}03$ for methylmethacrylate and $\sim 0{\cdot}15$ for methylacrylate and acrylonitrile.

Detailed experimental results with a full discussion will appear elsewhere.

Chemistry Department, V. MAHADEVAN.
University of Madras, M. SANTAPPA.
C/o American College,
Madurai 2, *September* 28, 1959.

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ESTIMATION OF HYDROXY ACIDS BY PHOTOCHEMICAL OXIDATION WITH Ce (IV)

Ce (IV) is known to oxidise, 1, 2 oxygen containing compounds. The oxidation takes place by refluxing the organic hydroxy acid with Ce (IV) in presence of appropriate sulphuric acid concentration. The products of oxidation under these conditions were formic acid or higher fatty acids, carbon dioxide and water. Such oxidations can also be carried out in presence of sunlight or some artificial light. It is found during our present investigation that the radiations of 575 mμ are most effective. The time required for the oxidation is found to vary from 15 to 30 minutes in rectangular cells of dimension ($4 \times 3 \times 0{\cdot}75$ cm.) compared to 1 to 3 hours in oxidation by reflux.

Oxidation of Glycollic, Lactic, Malic, Tartaric, Citric and Mandelic acids are studied by exposing the mixtures containing sulphuric acid (2 to 4 N) and Cerium (IV) solution and the organic acid. Monochromatic radiations are isolated by means of Kodak spectrum glass filter (575 mμ) supplied with *Hilger Spekker Absorptiometer*. The radiations are allowed to pass through the solution in the stoppered glass cell kept in dark chamber. The amount of Ce (IV) solution used in the oxidation of the organic acid was determined by back titrating the excess Ce (IV), with a standard Fe (II) solution using *Ferroin* as the internal indicator, with a micro burette. The results are tabulated in Table I.

TABLE I

S. No.	Acid	Vol. of 0·0125 M acid in ml.	Vol. of 0·02 N Ce (IV) consumed in ml.	Sulphuric acid conc.	Time of completion in minutes	Equivalents per mole: Calc.	Equivalents per mole: Found
1	Glycollic*	2·0	5·02	4 N	25	4	4·02
2	Lactic†	2·0	5·00	4 N	25	4	4·00
3	Malic‡	1·0	4·98	2 N	15	8	7·97
4	Tartaric‡	1·0	3·75	2 N	15	6	6·00
5	Citric‡	0·5	4·375	2 N	20	14	14·00
6	Mandelic§	2·0	5·01	2 N	15	4	4·00

* Calculated for oxidation to carbon dioxide and water; † Calculated for oxidation to acetic acid, carbon dioxide and water; ‡ Calculated for formic acid, carbon dioxide and water; § Calculated for oxidation to benzoic acid, carbon dioxide and water.

It is observed that the oxidation proceeds fairly rapidly even at room temperatures. In all cases the amounts of Cerium (IV) consumed are proportional to the amounts of the hydroxy acid taken up to the concentrations 5 to 30 mg. The photochemical oxidation of hydroxy acids with Ce (IV) is simple, rapid and adoptable for the estimation of these acids. The method has the special advantage of being applicable even when the substances are present in micro quantities.

The method has been extended for the estimation of polyhydroxy compounds also and the studies are under investigation. The detailed results are communicated elsewhere.

Department of Physical Chemistry, N. K. MATHUR. S. P. RAO.
Jaswant College,
Jodhpur, *November* 25, 1959.

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HIGH STRETCH PAPER FROM COCONUT COIR

PAPER of high stretch properties is required for certain special uses. Such paper is at present imported into India. An investigation was, therefore, undertaken in this Institute to produce such paper from indigenous cellulosic raw materials.

X-ray studies of various Indian fibres at this Institute by Narayanamurti and Prasad[1] revealed that coconut coir fibre should be capable of high stretch. Therefore, several digestions of coir using the sulphate process ($NaOH : Na_2S = 3 : 1$) at 170° C. for a total period of 4 hours (including 2 hours to reach maximum temperature from room temperature) were carried out. The pulps obtained were beaten in the Lampen Mill and standard sheets of about 60 g. per sq. m. were prepared and tested for various strength properties. Optimum results were obtained when 20% chemicals were employed for digestion. The unbleached yield was 44·6%. The strength properties of the pulp beaten to about 300 ml. freeness (C.S.F.) are given in Table I. Comparative figures for optimum strength properties of standard sheets made from pulps also beaten to about 300 ml. freeness from several other raw materials tested earlier in this Institute are also given in Table I. In this table, except for bamboo, the main fibrous raw material for the Indian paper industry, results of only those raw materials which give a stretch of over 5% are included.

It will be seen from the results given in Table I that coconut coir fibre gives a paper of very much higher stretch properties than any other indigenous raw materials tested so far in this Institute. The tearing resistance of coconut coir fibre is comparatively high. As expected, its tensile strength is appreciably lower than that of the other raw materials listed in Table I. Its bursting strength and folding endurance are slightly lower than those of the other raw materials, but are sufficient for the purposes for which high stretch papers are used.

Pilot-plant trials are shortly being undertaken to confirm the laboratory results on a large scale.

Cellulose and Paper Branch, S. R. D. GUHA.
Division of Chemical Technology,
Forest Research Institute,
Dehra Dun, *November* 16, 1959.

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TABLE I

Strength properties of standard pulp sheets made from various indigenous cellulosic raw materials

Serial No.	Raw materials	Breaking length metres	Tear factor	Folding endurance (Schopper) double folds	Burst factor	Stretch %	Reference to previous F.R.I. publication
1	Coconut coir	4350	107	302	36·4	9·0	Published now for the first time
2	Bamboo	9090	106	..	58·6	3·4	*I.F.B.** 112
3	Kusal grass	9000	98·5	290	53·4	5·1	*I.F.B.* 161
4	Blue gum wood	7610	122·5	1100	57·4	5·0	*I.F.B.* 196
5	Ulla grass	8980	120	1070	58·8	5·0	*I.F.B.* 163
6	Paper mulberry wood	9010	81·8	1200	48·2	5·0	*I.F.B.* 156
7	Elephant grass	8780	95·8	580	70·4	5·0	*I.F.B.* 183
8	Nal grass	8400	77·0	580	43·1	5·0	*I.F.B.* 157

* *Indian Forest Bulletin* (available from Manager of Publications, Delhi).

REACTIONS OF CHALKONES

ALTHOUGH a large number of chalkone derivatives have been synthesized by different authors, very little work has been reported on chalkones containing a cyano group.[1]

In the present investigation a number of such chalkones were synthesized by the condensation of *p*- and *m*-cyanobenzaldehydes with different ketones. No chalkone derivatives however could be obtained with *o*-cyanobenzaldehyde.

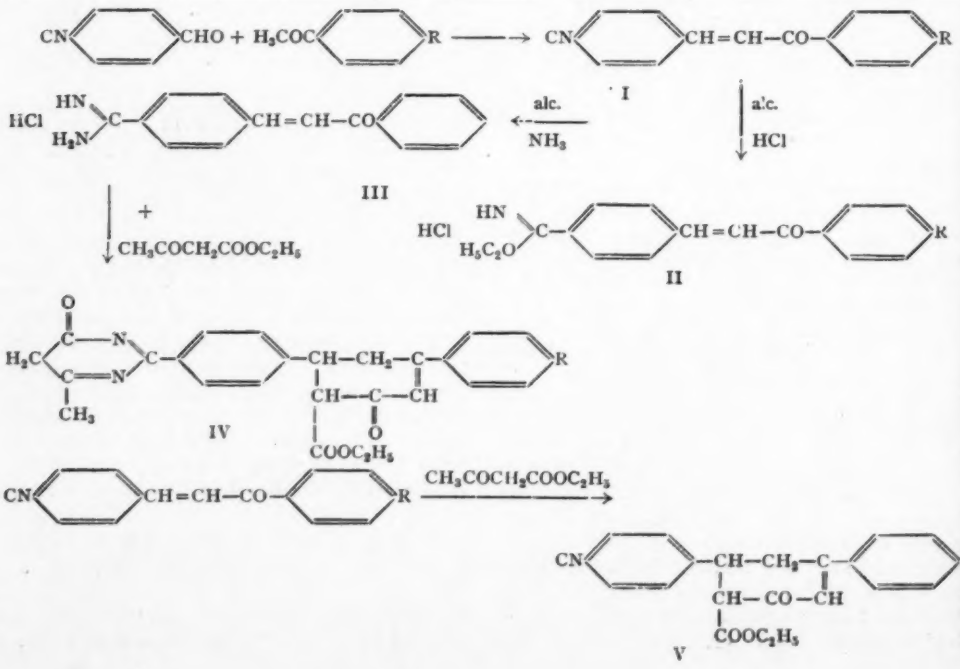
The cyanochalkones on treatment with hydrogen chloride in alcoholic solution yielded the corresponding imino ethers (II), which on reaction with alcoholic ammonia gave amidine-hydrochloride (III). The latter were condensed with ethylacetoacetate to give pyrimidine derivatives (IV) of the general structure shown on next page.

In addition to the reaction with the amidine group, the acetoacetic ester undergoes also Michael addition with the chalkone group. Michael's addition, using ethyl acetoacetate, has also been carried out with chalkones 1 and 2,

TABLE I

Chalkones 1 to 3 are  , Chalkones 4 to 6 are 

	Chalkone R = 1, 2	m.p.	Analysis Calculated	Analysis Found	Imino-ether hydrochloride m.p.	Amidine hydrochloride m.p.	Pyrimidine m.p.	Pyrimidine Analysis Calculated	Pyrimidine Analysis Found
1	$-OCH_3$	170°	C, 77·55 H, 5·00 N, 5·30	77·6 5·1 5·6	203°	275°	233-34°	C, 70·7 H, 5·8 N, 6·15	70·6 6·1 6·3
2	$-NH_2$	230-31°	C, 77·40 H, 4·80 N, 11·29	77·1 4·7 11·4	228° (decomp.)	200°	261° (decomp.)	C, 70·4 H, 5·6 N, 9·4	70·1 5·8 9·4
3	$-Br$	167°	C, 61·56 H, 3·20 N, 4·48	61·3 3·5 4·8	240-41°	range	247-48°	C, 61·5 H, 4·5 N, 9·4	61·2 4·2 9·5
4	$-OCH_3$	141°	C, 77·55 H, 5·00 N, 5·30	77·4 5·2 5·5	144-46° 208°	127-29°	190-91°	C, 70·7 H, 5·8 N, 6·15	70·9 6·0 6·4
5	$-NH_2$	223°	C, 77·40 H, 4·80 N, 11·29	77·2 4·6 11·00	(decomp.)	220-21°	275° (decomp.)	C, 70·4 H, 5·6 N, 9·4	70·7 5·9 9·8
6	$-Br$	147°	C, 61·56 H, 3·30 N, 4·48	61·6 3·5 4·6	..	..	..	..	..



giving adducts of the type (V), shown on p. 94. The adduct of (1) melted at 136-37°, (Calcd.: C 73·6; H 5·6; N 3·7; Found: C 73·6; H 5·7; N 3·8). The adduct of (2) melted at 185-86° (Calcd.: C 73·3; H 5·55; N 6·77; Found: C 73·4; H 5·7; N 7·9).

Condensation also occurs with ethyl malonate and ethyl cyanoacetate. A detailed paper regarding the structures of these products will be published elsewhere.

Institute of Science, Bombay-1, December 1, 1959.
J. R. MERCHANT.
A. S. U. CHOUGHULEY.

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INVESTIGATIONS ON *ZANTHOXYLUM RHETSA*, DC.

Zanthoxylum rhetsa, DC. (N.O. Rutaceæ; Hindi—pepuli; Marathi—chirphal, tirphal) grows in Southern India. Its fruits are astringent and stimulant and are used in hiccough, asthma, bronchitis, heart diseases, etc. The root bark is used as a purgative.[1] Essential oil of fruits, which has been studied for its chemical constituents[2] and antibacterial activity,[3] is used in cholera. Isolation of two alkaloids, budrungaine (charring above 180°) and budrungainine (m.p. 155°), from Z. *budrunga* Wall.[4,5] has been reported. In view of its importance in the indigenous systems of medicine, detailed investigations of different parts of the tree have been undertaken.

The bark, collected from Mudgeri, District Karwar, was successively extracted with petroleum ether (b.p. 60-80°), ether, alcohol, etc. The petroleum ether extract gave a crystalline triterpene, $C_{30}H_{50}O$ (m.p. 214°; yield 0·43%), which has been identified from its characteristic colour reactions, properties of its derivatives and mixed melting-point determination, as lupeol.

Two crystalline substances have been isolated from the alcohol extract of the defatted drug. A yellow crystalline base (m.p. 179-180°; yield 0·1%), provisionally named Pepuline, is sparingly soluble in most of the organic solvents, decolourises bromine water and potassium permanganate solution and forms hydrochloride, nitrate, sulphate, methiodide and platinichloride.

The hydrochloride of the base after repeated crystallisations from absolute alcohol melted at 222°. Its probable molecular formula, $C_{28}H_{29}N_4O_3$, HCl, has been deduced from microanalytical results and molecular weight determination (Found: C 66·42; H 5·81; N 11·86; Cl 6·98%; mol. wt. 508, $C_{28}H_{29}N_4O_5$, HCl requires C 66·46; H 5·934; N 11·09; Cl 7·023%; mol. wt. 506).

The hydrochloride has a stimulating action on the mammalian heart and a spasmolytic effect on smooth muscle.

A second crystalline substance (m.p. 256-258°), which is insoluble in most of the solvents except pyridine, glacial acetic acid and aqueous sodium hydroxide, was obtained in a quantity too small for further examination. (Found: C 52·19; H 5·23%; $C_{13}H_{16}O_8$ requires C 52·00; H 5·33%).

Our thanks are due to the college authorities for facilities to carry out this work and to Dr. S. M. Sethna, Professor of Chemistry, M.S. University, Baroda, for the microanalyses reported above.

Department of Pharmaceutical Chemistry, L.M. College of Pharmacy, Ahmedabad-9, December 20, 1959.
C. R. MEHTA.
R. C. MEHTA.
N. G. RANA.

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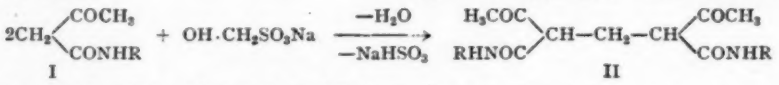
FORMATION OF METHYLENE-BIS-DERIVATIVES

1. Acetoacetarylamides by Means of Sodium Hydroxy Methane Sulphonate

SUTER, BAIR AND BORDWELL[1] carried on sulphomethylation reactions with phenols and compounds containing carbonyl groups, wherein from ethyl malonate they obtained its dimethane sulphonate, using the mixture of 40% formaldehyde with a solution of sodium sulphite; they also believed acetoacetic ester to have reacted in a similar manner. Shearing and Smiles[2] from 2-naphthol, by means of the mixture of solutions of formaldehyde and of sodium sulphite, prepared sodium 2-hydroxy-1-naphthylmethane sulphonate in part by a cleavage of bis-(2-hydroxy-1-naphthyl) methane with sodium sulphite; they further observed that 6-bromo-2-naphthol gave its sulphonate together with bis-(6-bromo-2-hydroxy naphthyl)-1-methane. The process is shown to be reversible when sulphonate and naphthoxide interact to give the bis-derivative with an elimination of sodium sulphite.

In the present work, sodium hydroxy methane sulphonate[3,4] ($OHCH_2SO_3Na$) is allowed to react with methylene-CH_2-group of the substituted amides of acetoacetic acid (I); and the products isolated from the reaction mixture are found to be methylene-bis-derivatives (II) of the corresponding acetoacetarylamides (I). The course of reaction is believed to have taken place through the intermediate formation of sulphonates of (I), with which hydrogen atom of the reactive methylene group of unreacted molecule of the amide simultaneously interacts, yielding only the corresponding methylene-bis-derivatives (II), with an elimination of sodium bisulphite as under:



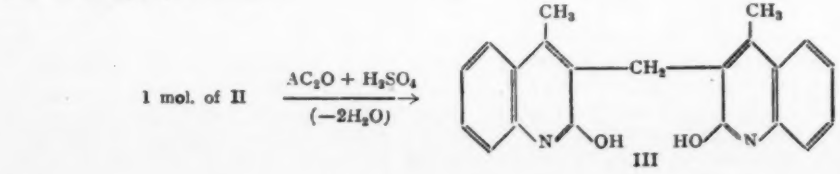
I II

where, R is phenyl, tolyl, xylyl and naphthyl radicals. The reaction mixture is refluxed in 90% methanol and the product crystallised from acetic acid in 55-60% yield.

2. Quinoline Derivatives on Cyclisation of Methylene-Bis-Acetoacetarylamides

Ewins and King[5] cyclised acetoacetarylamides to give 2-hydroxy-4-methyl quinoline derivatives in presence of concentrated sulphuric acid. Jean De' combe[6] cyclised the condensed product of acetoacetanilide and chloral in presence of sodium acetate giving 2-hydroxy-3 (1-hydroxy-2, 2, 2-trichloroethyl)-4-methyl quinoline. Bangdiwala and Desai[7] obtained 4-hydroxy quinoline derivatives on cyclisation of crotonates using acetic anhydride and conc. H_2SO_4; they observed that the presence of anhydride prevents the tendency of decomposition of intermediate product undergoing cyclisation.

In the studies of 4-hydroxy quinoline derivatives formed through ethoxy methylene malonic ester, Price *et al.*,[8,9] prepared a number of 6 : 6'-bis-(4-hydroxy quinolyl) sulphide derivatives. Here in this work 3 : 3'-methylene-bis-(2-hydroxy-4-methyl quinoline) derivatives (III) have been synthesised on cyclisation of the corresponding methylene-bis-derivatives of acetoacetarylamides (II) using acetic anhydride and conc. H_2SO_4 as under:



III

where R, is phenyl, tolyl, xylyl and naphthyl radicals: Acetoacetarylamides (I) have been prepared by the method of Ewins[5] modified by Naik.[10]

To a mixture of methylene-bis-derivative (II : 0·01 M) and acetic anhydride (3 c.c.), conc. sulphuric acid (3 c.c.) was gradually added. The reaction mixture was kept at room temperature for about half an hour with a calcium chloride guard tube, when considerable heat was developed; it was then heated on a steam bath for about 5 minutes. The mixture on pouring in excess of ice-water gave brownish-white mass. The filtered mass after charcoaling, was crystallised from acetic acid. The products are found to be pure but the yields are about 40-45%. Further work on compounds of types II and III is in progress and the details will be published elsewhere.

One of the authors (G. H. P.) thanks the M.S. University of Baroda for a Research Assistantship to carry out this work.

Faculty of Science, C. M. Mehta.
Chemistry Department, G. H. Patel.
M.S. University of Baroda,
Baroda, *December* 7, 1959.

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SURVIVAL OF RHIZOBIA IN PEAT-BASED LEGUME INOCULANTS

THE effect of storage in refrigerator on survival of rhizobia in eleven peat-based legume inoculants on sale in New Zealand has been studied during seven months, since the viable count of an inoculant is a criterion used for assessing its quality.[2] Viable counts determined at monthly intervals by plating in duplicates at 10^5 dilution, on yeast-mannitol agar[1] and incubating at 25° C. for ten days are expressed in Table I along with the average logarithmic decline per month (K) and its reciprocal (1/K), the time in months for a ten-fold reduction.[4] From K values, all the products seem satisfactory and refrigeration a dependable measure of preservation. However, the rate of decline (1/K) seems to give a better picture for judgement of their quality. At all events, factors, *viz.*, initial rhizobial count, the sterilized or unsterilized nature of substrate moisture content and aeration greatly influence viability levels in these inoculants.[3]

Full details will be published elsewhere.

My sincere thanks are due to Dr. I. D. Blair, Head of the Department of Microbiology, Canterbury Agricultural College, Christchurch (N.Z.), under whose guidance the above work was carried out, and to Mr. A. S. Chawla, Central Statistical Organisation, New Delhi, for statistical examination of the data. I wish to express my gratitude to the Government of New Zealand, for the award of a fellowship under the Colombo Plan which enabled me to carry out the studies reported.

September 25, 1959.

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TABLE I

Viable count of rhizobia per gram of the inoculant on moisture-free basis ($\times 10^6$)

Month	*1	2	3	4	5	6	7	8	9	10	11
March ..	2·79	2·89	5·00	8·77	10·81	3·44	..	..	..	..	..
April ..	2·53	1·45	7·50	11·43	17·57	2·30	38·59	..	..	..	..
May ..	2·53	2·89	10·00	14·29	14·87	2·30	36·84	..	10·29	8·06	10·00
June ..	2·53	4·34	10·00	18·57	21·62	5·74	29·82	12·07	8·82	9·67	8·57
July ..	2·53	2·89	7·50	22·86	16·22	4·59	35·09	8·62	8·82	9·67	7·14
August ..	1·26	1·45	1·25	7·14	13·52	1·14	21·05	5·17	4·41	9·67	5·71
September ..	..	1·45	1·25	5·71	10·81	..	17·54	3·44	2·94	3·22	5·71
'K' ..	0·151	0·173	0·349	0·278	0·038	0·349	0·091	0·185	0·173	0·143	0·063
1/'K' ..	6·6	5·79	2·87	2·33	10·17	2·86	10·95	5·38	5·78	6·97	15·97
Moisture % initial ..	21·43	28·59	20·34	30·83	26·48	13·41	43·67	41·73	32·68	38·23	30·56
Moisture % final ..	21·87	29·25	20·94	30·98	27·51	13·52	42·90	41·56	33·03	37·95	30·85

* Inoculant numbers 1 to 4 manufactured in U.S.A., 5 to 9 in Australia and 10 and 11 in New Zealand.

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A SIMPLE APPARATUS FOR PAPER ELECTROPHORESIS

PAPER electrophoresis has become an important tool for biochemical and clinical research and numerous types of apparatus for paper electrophoresis have been described.[1] A simple apparatus for horizontal type of paper electrophoresis similar to the one described by Grassman,[2] but with certain modifications, was constructed sometime back and has been in use for routine work in this laboratory.

The cabinet (Fig. 1) consists of a rectangular tank, 35 cm. × 20 cm. × 4·5 cm. (A), made of cut sheets of Perspex, with a heavy glass lid resting on it. The glass lid is provided with two narrow holes, through which are inserted two copper contact-screws carrying two leads (ordinary insulated wire) to the inner end of which are fused platinum wires 3" long. These platinum wires act as electrodes (E, E.). Two Perspex boxes 10 cm. × 6 cm. × 3 cm. (B) which are movable, are placed lengthwise 12 cm. apart inside the cabinet and in each of these rectangular boxes, two removable Perspex partitions

(O_1 and O_2) with a central hole are provided to act as baffle plates. These divide the box into three compartments, the extreme one serving as the electrode chamber. The first plate (O_1) also aids in fixing the paper in position.

Two glass rods (R_1 and R_2) are fixed to the compartment breadthwise 17 cm. apart and 4 cm. above the base. A filter-paper of size 30 cm. × 5 cm. (Whatman No. 1 or 3) passes over the glass rods and under the partition plates which keep it in position. Care was taken that the rectangular boxes containing the buffer solution were on the same level to prevent siphoning. The baffle system provided also prevents the pH changes at the electrodes from reaching the inner compartments. The rectangular boxes can be slightly moved backwards to make the filter-paper remain taut before the application of the test fluid.

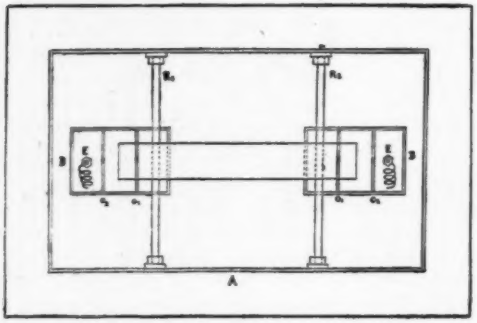

FIG. 1. Plan.

The circuit diagram of the power unit used in conjunction with the cabinet designed above is shown in Fig. 2.

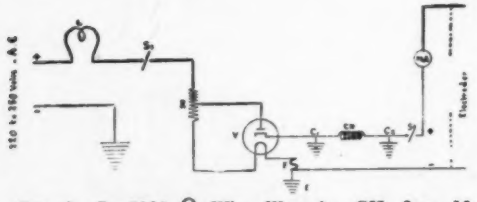

FIG. 2. R : 1000 Ω Wire Wound ; CH : 8 to 10 Henries ; C_1 : 6 MFD–500 V oil filled ; C_2 : 4 MFD–500 V ; mA : Milliammeter–0 to 50 mA ; F : Fuse ; S_1 and S_2 : Control Switches ; L : Safety Lamp 25 or 40 Watts.

The electrode leads are connected at points shown in Fig. 2 thus : the contact-screws on the glass cover plate are connected to the two terminals of the power unit supplying the D.C. The voltage of this supply varies from 120-140 volts depending upon the safety lamp used.

The procedure described by Flynn and Mayo[3] was adopted for the application of serum and staining of serum proteins. A good separation was obtained in six to seven hours. The same power unit was also used in conjunction with the electrophoretic cabinet (A.H.T. Co. Cat. No. 4937-W 5) of Arthur H. Thomas Co., Philadelphia. The separation of the human serum proteins using the present apparatus is comparable and almost identical with the separation obtained with the company's model, as seen in Fig. 3 [(1) A.H.T. Co. and (2) author's apparatus].

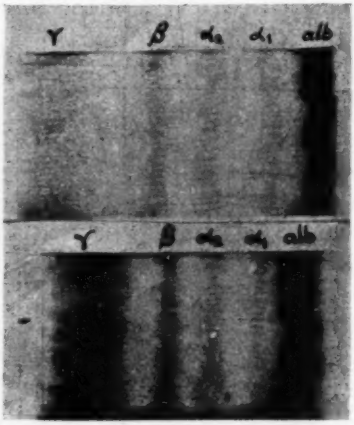

FIG. 3

Among the advantages of the new design of the apparatus described above may be mentioned the following :

(1) The apparatus can be easily fabricated at a very low cost. (2) Only a small volume of the buffer solution is required. (3) The two small containers for the buffer are removable, thus facilitating their quick cleaning. (4) The rectangular boxes being movable, help in making the paper taut to give efficient separation. (5) Fairly dependable separation can be obtained within the working hours of a routine clinical laboratory.

My thanks are due to Dr. P. Soucou, Director of Medical Services, Pondicherry, for kind encouragement during this work.

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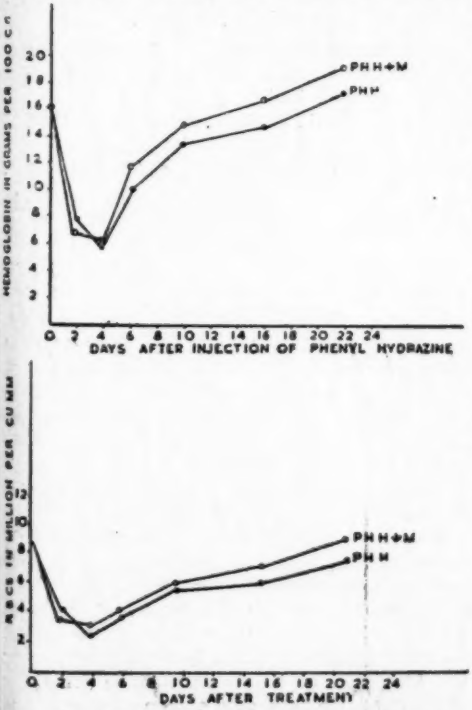
EFFECT OF INJECTED METHIONINE ON THE REGENERATION OF ERYTHROCYTES IN PHENYL HYDRAZINE-INDUCED ANAEMIA

VITAMIN B_{12} plays an important part in the biosynthesis of labile methyl groups and in the reduction of -SH compounds.[1] A sparing action of Vitamin B_{12} on the methionine requirements of animals is also believed to be due to this physiological function. It is also known that *dl*-methionine is utilized in the synthesis of both hæm and globin fraction of hæmoglobin.[2] A beneficial response of injected vitamin B_{12} in the regeneration of erythrocytes in phenyl hydrazine induced anæmia has also been reported by Vijayaraghavan and Dunn.[3] In the present experiment the effect of injected methionine in erythropoiesis in animals made anæmic by a single dose of phenyl hydrazine was studied, and some interesting results were obtained.

Forty-five young male albino rats weighing between 80 gm. and 120 gm. on a stock diet consisting of 75% wheat flour, 10% casein, 5% yeast powder, 5% salt mixture (Mc Collum), 5% gingelley oil were taken for the experiment. A single dose of phenyl hydrazine hydrochloride 80 mg./kg. body weight was injected subcutaneously to all the animals. The solution for injection was prepared as described by Chanutin *et al.*[4] Twenty animals were kept as control. To the rest were given daily subcutaneous injections of 100 mg./kg. body weight of a solution of *dl*-methionine (B.D.H.) in saline. Control and experimental animals were sacrificed in the morning in a fasting state by decapitation at regular intervals before injection, after 2 days, 4 days, 6 days, 10 days, 16 days and 22 days following injection. Blood was collected in an oxalated beaker and R.B.C. count as well as hæmoglobin estimation were done.



FIGS. 1–2. Effect of injected methionine on the regeneration of erythrocytes in phenyl hydrazine-induced
PHH = Phenyl hydrazine only (Control).
PHH + M = Phenyl hydrazine + Methionine.

Single administration of phenyl hydrazine induced a rapid destruction of erythrocytes and a fall in both the red cell count and hæmoglobin level. The maximum fall was observed on the 5th day in both the control and experimental animals. From the 7th day onwards a regular rise in erythrocytes and increase in hæmoglobin level were observed. The increase was, however, more pronounced in the animals receiving a daily injection of methionine than in the controls. No protection was however observed with methionine till the 5th day of phenyl hydrazine injection.

Both R.B.C. and hæmoglobin were above the initial normal level in the animals treated with methionine and the values were estimated on the 22nd day of experiment.

Thus methionine has a beneficial effect in animals rendered anæmic with phenyl hydrazine. Its role is more or less similar to that of vitamin B_{12} in the same condition. Further work in this direction is in progress.

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NITROGEN FIXING ORGANISMS IN COCONUT RETTING GROUNDS IN KERALA

In Kerala, the coconut husks are retted in water in the low lying areas and covered with a layer of soil. In due course the decomposition of organic material starts and these grounds become a seat of immense biological activity as evidenced by presence of sulphur on the surface and occasional strong smell of hydrogen sulphide.

Soils from these retting grounds were examined during a survey of the water-logged soils of the State and compared with those from the paddy fields. Samples were examined at the Agricultural College, Vellayani, and were analysed for total nitrogen, soluble salts, phosphate and potash content. Results are given in Table I.

Table I
Analysis of soils

	Sample from	
	Retting grounds	Kayamkulam lake area
	%	%
Nitrogen ..	0·43	0·01
P_2O_5 ..	Trace	0·003
K_2O ..	0·363	0·001
SO_4 ..	2·12	0·25
Chloride ..	0·75	0·73
pH ..	6·80	6·80

Microscopic examination of the soils revealed the presence of algæ and various types of bacteria. One gram of soil sample from the retting areas was inoculated into 50 ml. of Ashby's mannite solution and nitrogen fixing capacity of the organism determined. Results are shown in Table II.

Table II
Nitrogen fixation

	Period of incubation	
	1st week N_2 in mgm.	4th week N_2 in mgm.
Media *plus* soil sterilized	4·3	4·3
Media *plus* soil unsterilized	4·3	10·27

Results show that the soil from retting grounds had capacity to fix nitrogen. The bacteria responsible for the fixation of nitrogen were isolated and studied. The characteristics of these bacteria are as follows :—

The cells were coccoid often occurring in pairs with a tendency to show oval forms. Young cells were highly motile, and devoid of granules or fatty bodies, in old cultures they were surrounded by a thick capsular coating. Colonies were perfectly round with a moist smooth convex surface, turning turbid in alkaline media. The organism grew well at different reactions and utilised mannite and sucrose as energy material. The organism is capable of fixing 6-7 mgm. of nitrogen per gm. of energy supplied.

The observations showed that even under the abnormal conditions of retting grounds, nitrogen fixing organism akin to azotobacter flourishes. The nitrogen fixing capacity of about 7 mgm. of nitrogen per gm. of energy utilized, compares well with that of normal azotobacter.[1] In addition to this the presence of algæ in the retting grounds is also likely to create a symbiotic condition responsible for comparatively larger amount of nitrogen present in the retting grounds. Germanov (1927) has also suggested that presence of sulphur compounds gives an impetus for nitrogen fixation. Results therefore show that even under anaerobic water-logged conditions, nitrogen fixating organisms-like azotobacter functions. Further studies are in progress.

Department of Chemistry, Agricultural College and Research Inst., Vellayani, Kerala State, *November* 20, 1959.

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N. Subramoney.

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INFLUENCE OF *ASPERGILLUS NIGER* AND *PENICILLIUM NOTATUM* ON COTTON-SEED OIL

Cotton-seed oil has been shown by Arkhangel Skii and Samoilov[1] to be almost completely sterile being an unfavourable medium for the existence and propagation of vegetative microorganisms and not owing to any fungicidal properties. The oil has been used as an aerobic yeast growth factor[2] and also in the production of penicillin[3] but practically no information is available regarding its use as a substrate. On reviewing the literature, the main obstacle to such work appears to be relatively few microorganisms capable of bringing about extensive changes in it. This suggested us to investigate the possibilities of cultivating *Aspergillus niger* and *Penicillium notatum* in medium containing cotton-seed oil as a sole carbon source and to study the nature of changes caused by these moulds in the physical and chemical characteristics of this oil.

The organisms employed were *Penicillium notatum* NRRL 1249-B-21 and *Aspergillus niger* NRRL 372 (98). These strains were first cultivated in basal media containing glucose and optimal amount of various inorganic salts necessary for the respective mould (modified Czepex-Dox medium[4] nor *P. notatum* and Currie's[5] medium for *A. niger*). In the subsequent experiments the glucose in the medium was gradually replaced by cotton-seed and the respective mould was adapted by repeated subculturing to grow in shake flasks. This process was continued till all the glucose in the medium was replaced by cotton-seed oil. A locally refined grade of cotton-seed oil was used for this investigation.

Experiments were carried out in 500 ml. conical flasks carrying 100 ml. of the appropriate basal medium for each mould together with 10% (v/v) of cotton-seed oil (in place of glucose) which was added after sterilization. The flasks were shaken at a suitable rate to keep the oil in the form of a uniform emulsion. One set of flasks carrying respective medium without inoculation was run as a control under the same conditions. However, no growth was noted in this case.

Cotton-seed oil consists mainly of two unsaturated acids; oleic acid (22·9%), linoleic acid (50·4%) and one saturated acid, palmitic acid (26·7%). It is suggested from the results that *A. niger* mainly attacks oleic acid and *P. notatum* attacks both the unsaturated acids while neither of these two moulds appears to attack the saturated acid.

The change in iodine and thiocyanogen values together with the progressive rise in acid value indicate that oleic acid in case of *A. niger* and both oleic and linoleic acids in case of *P. notatum* are decomposed to free acids. The formation of free acids may be the result of the breaking of the ester linkages by lipase action as well as due to the chain splitting at the double bond of the unsaturated acids.

The initial rise in the rancidity of the oil may be due to the formation of ketones by cleavage at the double bonds of the oleic and linoleic acids, which are removed or broken down in the later stages of fermentation. Finally the appreciable in the melting-points of the resultant oils can be attributed to the possibilites of the removal of low melting components of the oil and to the formation of free fatty acids since mixed fatty acids of an oil have a melting-point higher than the oil itself. Further work is in progress.

TABLE I

Micro-organisms employed	Incubation time (weeks)	Melting point °C.	Degree of rancidity	Acid value	Iodine value	Thio-cyanogen value	Oleic acid*	Linoleic acid*	Saturated acids*
Control ..	..	- 10 to −5	15	1·5	111·7	67·8	22·9	50·4	26·7
Aspergillus niger ..	3	34-37	23	93·3	106·7	61·8	15·0	51·5	33·5
	4	38-42	43	105·8	99·8	58·9	16·6	46·9	36·5
	5	35-40	28	120·4	97·5	51·5	2·1	52·9	45·0
Penicillium notatum ..	3	29-31	63	23·5	40·9	25·8	10·7	17·3	72·0
	4	30-32	31	79·1	31·7	18·4	4·6	15·3	80·1

For analysis the contents of four flasks were pooled and the oil was extracted with redistilled petroleum ether (b.p. 40-60° C.). The ethereal extract was passed through a column of anhydrous sodium sulphate and evaporated at room temperature. British Standard Methods[6] were employed for determination of melting-point, free fatty acids, iodine value (by Wiji's solution), thiocyanogen value and for the calculation of approximate composition of fatty acids. The degree of rancidity is expressed as colour density at 680 mμ in terms of galvanometer readings of a photoelectric colorimeter, when one gram of the oil was subjected to Kries test as described by Pyke.[7] The results are summarized in Table I.

Thanks are due to the staff of the Fermentation Research Division of the Northern Regional Research Laboratories, Peoria, Illinois (U.S.A), who very kindly supplied the strains of micro-organisms employed during the course of this work.

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A NOTE ON A CORYNEFORM BACTERIUM PRODUCING γ-CAROTENE

In 1939 Dr. S. Mahdihassan[2] isolated from the insect *Cicadella viridis* a Gram-positive, rod-shaped bacterium producing β-carotene and named it *Mycobacterium carotinogen*. Subsequent studies have revealed[3-7] that the response it elicits to measured amounts of liver extracts in a basal medium is not only quantitative but holds promise of its use in the assay of liver extracts as well as vitamin B_{12}. A microscopical examination of the culture has pointed to the need for re-establishment of its identity. This report indicates that taxonomically the organism is related to *Corynebacterium* and can be characterised as a new species in the genus.

It is necessary to point out that the original culture made by Mahdihassan was maintained on prune extract agar and that it had to be subsequently cultivated by him on liver extract agar during the last war when prunes became unavailable in Germany. This had resulted in a change, from long to short rods, in the morphology of the bacterium. No subsequent changes, however, took place. The results of re-examination of this culture are presented below.

Growth temperature and media.—The organism does not grow on nutrient agar, nutrient gelatine, broth or potato. It grows only in media containing liver extract or compounded media containing B_{12}. It does not grow below 5° C.; good growth occurs at 25° C. on liver extract nutrient agar, giving rise to smooth, shining colonies, appearing oval-shaped under the low power of the microscope; equally good growth occurs at 37° C., but the colonies appear dry and club-shaped under the microscope; the organism dies at 50° C.

Oxygen relationship.—The organism is strictly aerobic.

Colony characteristics.—Bright red pigmented colonies on liver extract nutrient agar of pH 7·0 after 48 hours of incubation at 25° C.

Morphology and staining characteristics.—In young culture (2-3 days) oval-shaped forms to short rods; when old (5 days) club-shaped (Fig. 1). Non-motile and does not reveal any flagella on flagellar staining.

FIG. 1. *Corynebacterium carotenogenum* (5 days old), Gram-stained, × 3,500.

The organism is *not* acid-fast up to 120 hours during which period it was tested periodically five times. Metachromatic staining methods revealed the presence of metachromatic granules, conspicuously at the ends of each cell. These characteristics suggest that the organism belongs to the genus *Corynebacterium* and not *Mycobacterium*.

Biochemical characteristics in liver extract media.—Growth but no fermentation in glucose, sucrose, lactose, maltose, starch or glycerol.

Blood agar.—Growth but no hæmolysis.

Litmus milk.—No reaction.

Catalase.—Positive.

Indole.—Not formed.

Hydrogen sulphide.—Not produced.

Nitrate medium.—Nitrates reduced to nitrite.

Hydrolysis of starch.—Negative.

Liquefaction of gelatine, casein, coagulated egg and serum.—Not liquified.

Chemical nature of the pigment produced.—Not β-carotene; most probably γ-carotene.

Identity of the organism.—From the accounts given by Mahdihassan and those presented above and in light of the available information, the organism has to be placed in the genus *Corynebacterium*. In view of the fact that this organism demands liver extract for growth and produces carotene, the name *Corynebacterium carotenogenum*, sp. nov. is proposed for this organism.

The authors wish to thank Dr. J. Ganguly and Mr. S. Mahadevan of the Biochemistry Department for the characterisation of the pigment, Dr. M. K. Subramaniam of the Cytogenetics Laboratory for the photomicrography, Dr. S.

Mahdihassan for the supply of the culture and Drs. S. Bhagavantam and K. A. Hamied for their interest.

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THIAMINE AND BIOTIN REQUIREMENTS OF TWO STRAINS OF *GLOMERELLA TUCUMANENSIS* (SPEG.) ARX AND MUELLER

Glomerella tucumanensis, the sugarcane red rot organism, has been studied in culture by a number of workers.[1,2,6] Abbott[1] did not find any difference in the cultural requirements of the two types of strains he discovered in Louisiana. Ramakrishnan[6] observed that the organism could grow over a wide pH range and that the optimum lay between pH 4·5 and 5·0. Sucrose was the best source of carbon, with glucose coming next while other carbohydrates like starch, maltose and lactose were utilised less readily. The fungus could derive its nitrogen requirements from asparagine, peptone or potassium nitrate but not so readily from ammonium sulphate. Chona and Hingorani[2] found little difference in the optimum temperature, pH range, etc., for the growth in culture of three strains. The vitamin requirements of the fungus do not appear to have been studied.

Two strains, 244 and D, were used for determining heterotrophy towards certain vitamins. These strains are historically important being representative of the red rot flora involved in major epiphytotics in U.P. and Bihar.

Glucose-Asparagine solution purified by activated carbon[4] was used in the initial study. This revealed only a partial deficiency of thiamine. In later studies, a sucrose-nitrate medium[5] was employed. This medium was treated with Alumina[3] at pH 7·4, and later adjusted to pH 7·0. In spite of the subsequent addition of a full complement of the micronutrients Fe, Zn, Mn and Cu, there was no growth. The medium was then supplemented with additions of four vitamins—thiamine, biotin, pyridoxine and inositol, omitting one at a time. The two strains did not reveal any need for an external supply of pyridoxine or inositol but had deficiencies of thiamine and biotin. The alumina treatment appeared to be efficient in removing thiamine and biotin from this medium. In further experiments, it was shown to be better in this respect than activated charcoal.

Graded doses of thiamine and biotin were added to the purified medium. When the dose of thiamine was varied, biotin was added at 5 μg. per litre and when that of biotin was varied thiamine was added at 100 μg. per litre. The mean dry weight of mycelium at the end of one week (on 25 ml. of medium) and spore production per ml. of medium as determined with a hæmocytometer in respect of strain D are given in Table I. There was no appreciable difference between the two strains in respect of requirements of the two vitamins.

TABLE I

Dry weight of mycelium (mg.) and number of spores (× 10^3) per ml. of medium

Thiamine μg. per litre	Mycelium	Spores	Biotin μg. per litre	Mycelium	Spores
0	0	0	0	>5	0
5	23	0	0·5	76	2
10	68	6	1·0	83	39
25	143	19	2·0	157	93
50	310	138	3·0	268	123
100	368	283	4·0	365	290
200	379	262	5·0	387	286
500	393	27	10·0	372	260

There was progressive increase in mycelial weight with increase in dose of thiamine. Marked increase in sporulation occurred between 50 and 200 μg. of thiamine, but at 500 μg. sporulation was considerably suppressed. Visible sporulation occurred on the third day at doses of between 50 and 200 μg. but it took five days with lower doses. There was a progressive response in increased mycelial weight and sporulation to increasing doses of biotin up to 5·0 μg.

In further experiments, it was observed that at 100 μg. and higher doses of thiamine autolysis and loss in mycelial weight occurred after two weeks while at lower doses these did not take place till after four weeks.

The authors are grateful to Shri N. L. Dutt and Dr. N. R. Bhat respectively past and present Directors of this Institute for encouragement and to Prof. V. G. Lilly, West Virginia University, for discussions with the senior author on the feasibility of the technique.

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FLUVIOGLACIAL DEPOSITS IN THE OUTER HIMALAYAS

THE outermost hills of Kashmir Himalayas consist of the Siwaliks and the post-Siwaliks, hitherto believed to be composed of detritus derived from the weathering and erosion of the mountain terrain. This is true so far as the Lower and Middle Siwalik series are concerned but not in the case of the Upper Siwalik series and the post-Siwalik deposits which are fluvioglacial, as already shown by the author in regard to the Tatrot and Pinjor which are correlated with the Gunz and the post-Gunz period (*Nature*, Sept. 12, 1959).

The Boulder Conglomerate which is the youngest member of the Siwalik system contains boulders of the Murree series and of precambrian quartzite. Like the Pinjor stage, the quartzitic boulders and pebbles of this stage are beautifully polished and its matrix contains fresh grains of felspar. de Terra considers the stage to be of Middle pleistocene age corresponding to the Mindel age but its composition indicates that it must have been formed in the Mindel-Riss interglacial period as only the large-scale melting of the Mindel-ice could have given rise to streams strong enough to transport the huge boulders of the Murree sandstone and Quartzite. The Batote hills were probably glaciated during the Mindel stage.

The youngest deposits in the Outer Himalayas consist of pebbles and boulders loosely held together in a loamy matrix. The Quartzitic pebbles and boulders are very well polished and some of them faceted also, and the deposits were probably formed in the Riss-Wurm and the post-Wurm periods.

From the occurrence of fluvioglacial deposits in the Batote hills and neighbourhood it is concluded that similar pleistocene deposits must occur elsewhere in other parts of the outer Himalayas.

The author's thanks are due to Shri Bhatia and Shri Gandotra for their help in these investigations.

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ENZYMES OF HEPATICS
I. A Preliminary Report*

IN recent years physiological studies of Liverworts have been the subject of considerable experimental work and valuable contributions have been made by Voth and Hamner,[1] Fulford *et al.*,[2] Fulford,[3] Diller *et al.*,[4,5] Iverson,[6] Patterson,[7] Klingmüller,[8] Burkholder[9] and others. Most of these investigations have mainly centred round nutritional and cultural studies and striking results have been obtained as to the effect of organic and inorganic chemicals on the morphological and physiological make-up of these plants. Assimilation of these substances being the function of the various enzymes present in these plants, becomes a significant problem of study. Results of detailed investigations of the enzymes of certain common representatives of the group are briefly described here. As far as the authors are aware, the present contribution constitutes the first serious attempt on this aspect of study in Hepatics.

Four plants, *viz.*, *Riccia discolor* L. *et* L. (male and female), *Asterella angusta* (St.) Kachroo (male plants), *R. billardieri* Mont. *et* N. and *Plagiochasma intermedium* L. *et* G. (latter two monœcious) growing locally were investigated. Tips of vigorously growing healthy young plants (of approximately the same age) were utilized in each case. Plants were washed with cold sterile distilled water so as to remove all adhering soil particles and organisms

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associated with them. They were then dried in folds of sterilized blotting-paper, weighed and chilled under aseptic conditions in Deep Freeze at − 20° C. for the assay of enzyme activity which was done on the fresh weight basis.

The enzyme extract was prepared by utilizing the usual methods (Nason,[10] Bose and Sarkar,[11] etc.). Frozen thalli were thoroughly ground in chilled mortar with 5 ml. of cold glass distilled water. The resulting slurries were diluted to 20 ml. per gram of the material. The liquid obtained by squeezing the mash through folds of cheese cloth was centrifuged. The supernatant obtained after centrifugation at 3,000 r.p.m. in a refrigerated centrifuge at 5° C. for 20 minutes was immediately utilized for study. For comparing the enzyme activity, inactive enzyme preparations were also made. The general procedure adopted for the latter was the same except that they were autoclaved at 15 lb. pressure for 15 minutes. The assay of enzyme activity was conducted by the difference between the results of active and inactivated enzyme extracts following the methods adopted by Bose and Sarkar[11] and Nutman.[12]

The study so far has revealed the presence of the enzymes as summarized in Table I.

It seems highly probable from the results obtained so far that the metabolic processes in hepatics may closely correspond to those obtained in green tissues. Detailed papers on the kinetics of these and other enzymes and their significance in metabolic pathways will soon be published.

Department of Botany,
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Lucknow, *November* 6, 1959.

RAM UDAR.
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TABLE I

No.	Enzymes	Plants A	B	C	D	E	Substrate	Enzyme activity
1	Lipase ..	+	+	+	+	+	Olive oil emulsion	D>E>C>A & B
2	Butyrase ..	+	+	+	+	+	Ethyl acetate	D>E>B>C>A
3	Acid phosphatase ..	+	+	−	−	−	Sodium β-glycerophosphate	Almost equal activity
4	Phosphorylase ..	+	+	−	−	−	Glucose-1-phosphate	A>B
5	Amylase ..	+	+	+	+	+	Starch	E>D>C>A>B
6	Invertase ..	+	+	+	+	+	Sucrose	E>D>C>A>B
7	Maltase ..	+	+	+	+	+	Maltose	E>D>C>A>B
8	Urease ..	+	+	+	+	+	Urea	D>A>B>C>E
9	Proteolytic ..	+	+	+	+	+	Peptone	D>A>B>E>C
10	Ribonuclease ..	+	+	−	−	−	Ribonucleic acid	A>B
11	Catalase ..	+	+	+	+	+	Hydrogen peroxide	E>D>C>B>A
12	Laccase ..	+	+	+	+	+	Hydroquinone	E>D>C>B>A

Abbreviations in the table refer to : *R. discolor* (Male) for A, *R. discolor* (Female) for B, *R. billardieri* for C, *A. angusta* for D, *P. intermedium* for E in column for plants and enzyme activity.

\+ for presence of enzymes. − not investigated.

INFLUENCE OF DAY LENGTH ON STERILITY IN RICE

STERILITY in crop plants forms an interesting line of study because of its direct influence on grain yield.[1-4] Day length has been reported to have a great modifying effect on flowering behaviour of plants.[5] In the present investigation the aim was to study the effect of different photoperiods on sterility of the rice plant. Eighteen varieties of rice selected as representatives of different maturity groups such as early, medium-early and early-winter and late-winter from Orissa and Uttar Pradesh, were grown in pot experiments. As short-day treatment, a 10-hour day length (8·00 a.m. to 6·00 p.m.) and as long-day treatment, a continuous 24-hour day length was used as against

the natural day length (13 hour 30 minutes in June to 10 hour 30 minutes in December) of Allahabad (Lat. 25° 27′ N., Long. 81° 44′ E.). The following are some of the salient results that emerged out of this study.

(*a*) *Varietal difference.*—There was wide difference in percentage sterility among the different varieties even in the same maturity group under the influence of the same photoperiod. Percentage sterility under short photoperiod was in general higher in the early varieties than in the late-winter varieties. The medium-early and early-winter varieties did not show any marked changes in sterility either under short or long photoperiod.

(*b*) *Nature of photoperiod.*—Short photoperiods in general brought about a greater degree of sterility and long photoperiods a lesser degree of sterility in comparison with the controls both in the early and late groups of rice varieties. It is of interest to note that short days bring about a delay in ear-emergence in early varieties[6,7] but just the reverse effect of earliness in late varieties.[8] The fact that in spite of this opposite effect on flowering, the short photoperiod induces the same type of reaction with regard to grain setting points out that the photoperiodic requirements of a particular variety for the two different processes, flowering and gametogenesis, are different.

(*c*) *Quantity of photoperiod.*—The percentage sterility is greatly dependent on the length of the photoperiod. Short days prolonged till the time of flowering in most cases brought about a higher percentage of sterility than when they were administered for a shorter period. So normally the percentage sterility increases with increase in the length of the adverse photoperiod.

(*d*) *Stage of application of photoperiod.*—The stage of application of the photoperiod is of major importance because it was seen that photoperiod applied to young seedlings of 10-30 days old or to mature old plants beyond 60 days were much less effective than when the photoperiod was applied to 30-60 days old plants presumably because this is the period when the initiation and further development of the panicle takes place. So it is the formative stage of the plant that is most susceptible to photoperiod so far as sterility is concerned.

The present study, therefore, clearly establishes that just as nutrition, temperature, humidity, diseases and pests have a large influence on percentage of sterility so also photoperiod, either natural or artificial, has to a large extent a determining effect on the nature and quantitative aspects of seed-setting in a plant.

I am thankful to Prof. Shri Ranjan for his encouragement and the facilities he provided for this investigation in the Department of Botany of Allahabad University.

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A NOTE ON AN ASSOCIATION BETWEEN TWO ADULT EARTHWORMS

WHILE collecting specimens of *Drawida grandis* (Bourne) (Family Moniligastridæ) from Chittur-Cochin, the author came across an interesting association between this giant earthworm and another belonging to the family Megascolecidæ. Further collections confirmed that the association was of a definite epizoic nature and not a casual companionship between two earthworms.

Two to twelve of the Megascolecid worms, at various stages of growth, were found crawling about on the body of *Drawida* (Fig. 1). They

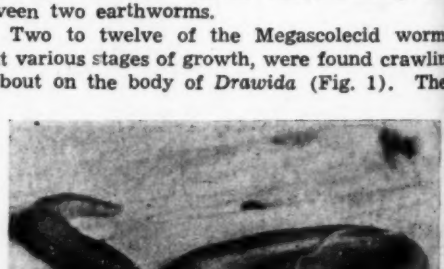

FIG. 1. Photograph of *Drawida grandis* with two specimens of Megascolecid crawling on its body.

were small, pinkish-white worms, ranging from 11 to 32 mm. in length (when preserved), with about 85 clearly marked segments. Their depressed body showed a broad anterior end tapering posteriorly into a blunt point. A wide,

longitudinal groove along the entire dorsal side of the worm, nicely fitting on to the arching body surface of *Drawida* formed a distinctive feature of the species. The animal crawls on its dorsal side over the body of *Drawida* keeping its mouth turned outwards. The position of the mouth together with the fact that *Drawida* lacks dorsal pores suggest that these Megascolecids probably do not feed on the lymphocytes or exuded fluids from the coelome of the former. A study of the gut contents showed only fine soil particles and some mucus as in any other earthworm.

These worms were found only in association with *Drawida*, and when removed from the "host" they were seen to seek and crawl on to the side of the latter. Within the burrow they wander all over the body of the "host" but when taken out and exposed they glide on to the underside as if seeking cover. Studies of their prepared sections have shown that the worms were adults.

A number of associations between earthworms have been recorded as commensalism.[1] Two instances of association between earthworms themselves are known, and they both refer to commensalism between Microdrili and Megadrili. Baylis[2] has observed an association between an Enchytreid *Aspidodrilus* and a large earthworm, and Cernosvitov[3] has observed a similar relation between the Enchytreid *Fridericia parasitica* and the earthworm *Allolobophara robusta*. The relationship recorded here is interesting as it shows an association between adults of two genera of Megadrili.

The author is indebted to Dr. K. K. Nayar for guidance in the preparation of this note. Complete description of the Megascolecid together with details of its ecology will be published elsewhere.

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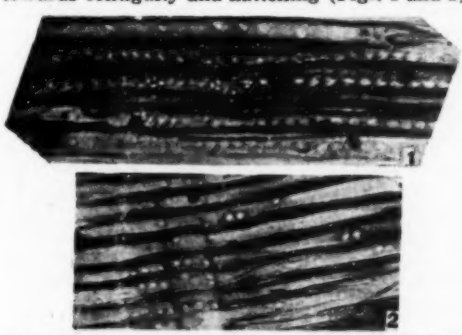
ON THE ANATOMY OF THE SEEDLINGS OF *ARAUCARIA BIDWILLII* HOOK. AND *AGATHIS BROWNII* L. H. BAILEY

Not much work seems to have been done on the seedling anatomy of the Indian conifers. Earlier investigators[1,3] have recorded the mode of germination and other histological changes in the root-stem transition region. Jeffrey's[2] observation on *Agathis australis* appears to be the only reference at present available with special reference to radial pitting. Barring these few references, the seedling woods of other species do not appear to have been investigated, while their mature woods have been studied quite extensively. During the course of study on the anatomy of the acclimatised conifers of South India in this laboratory, anatomical studies were extended to certain conifer seedlings also, and the results obtained on *Araucaria bidwillii* Hook. and *Agathis brownii* L. H. Bailey are given below.

In *Araucaria bidwillii* Hook. radial pitting is not only uniseriate, but also separate, while in *Agathis brownii* L. H. Bailey it is separate, the pits in later formed tracheids in both species tending to become contiguous and flattened, and having circular or cross-wise apertures (Figs. 1 and 2).

The seedling woods in both species show well spaced uniseriate pits in the initial stages, a few pits in the later formed tracheids tending towards contiguity and flattening (Figs. 1 and 2).

Jeffrey[2] has mentioned that in the seedling wood of *Agathis australis*, "the pits are neither crowded nor alternating as in the wood of the adult". Similarly in the present study also, the seedling woods of the two Araucarians display widely separate pits. But, in addition to this, a few pits in the later-formed tracheids of both the seedlings have been observed tending towards contiguity and flattening (Figs. 1 and 2).



FIGS. 1 and 2. *Araucaria bidwillii* Hook. and *Agathis brownii* L. H. Bailey respectively showing 3rd longitudinal section of seedling stem, showing both uniseriate separate and contiguous bordered pits, ×333.

This tendency on the part of pits in the Araucarian seedlings does not appear to have been recorded before. It is felt that this tendency is the first step towards multiseriate pitting of the mature Araucarian wood. It, therefore, appears that the multiseriate pitting

characteristic of the mature wood is a secondarily derived condition.

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INSECTICIDAL TRIALS AGAINST TERMITES INFESTING WHEAT PLANTS UNDER UNIRRIGATED ('*BARANI*') CONDITIONS

THE insecticides used in these field trials were technical toxaphene and technical dieldrin. There were two dosages, *i.e.*, 10 and 15 lb./acre of each insecticide. The source and form in which these insecticides were obtained have been reported earlier.[1,2] Each insecticide was broadcast in different plots before sowing according to a randomised plan, there being no further insecticidal treatment during the entire season. The number of germinated plants and those damaged by termites were counted in each plot and the percentage of damage was calculated. The data together with the statistical analysis are presented in Table I.

TABLE I

Showing percentage of damaged wheat plants and yield in different treatments

Insecticides and dosage	Average % damage of plants in 3 replications	Average grain weight in lb. in 3 replications
(*a*) Technical dieldrin used @ 10 lb./acre	19·1	9·0
(*b*) Technical dieldrin used @ 15 lb./acre	10·8	9·3
(*c*) Technical toxaphene used @ 10 lb./acre	55·3	3·7
(*d*) Technical toxaphene used @ 15 lb./acre	70·2	6·2
(*e*) Control (untreated)	84·5	1·8
	'F' test highly significant. S.Em = ±6·51 C.D. at 5% = 21·23 C.D. at 1% = 30·89	'F' test highly significant S.Em = ±1·22 C.D. at 5% = 3·98 C.D. at 1% = 5·79

It can be seen from Table I that the analysis of the data on percentage damage of plants by termites showed highly significant differences at 1% level between the control and the treatments, the control showing the maximum percentage damage. The dosages of the two insecticides, did not differ significantly between themselves. The percentage of damaged plants by termites in plots treated with toxaphene did not differ significantly from the control at 1% level. Only dieldrin treated plots showed significantly less percentage damage. The analysis of the data on the yield of grain showed highly significant differences at 1% level. Plots treated with dieldrin (10 or 15 lb./acre) gave significantly higher yield than control but the dosages did not differ between themselves. Treatment with toxaphene at 15 lb./acre was found to give significantly higher yield over control only at 5% level. However, the plots treated with toxaphene at 10 lb./acre did not differ from control. The maximum yield was obtained in dieldrin treated plots followed by toxaphene and control.

It will thus be seen that plots treated with dieldrin at the above-mentioned dosages showed significantly less damaged plants and higher yield than those treated with toxaphene and control plots.

The authors are thankful to Dr. E. S. Narayanan, Head of the Division of Entomology, for his keen interest in the investigations. Thanks are also due to Dr. P. N. Saxena, Head of the Section of Statistics, for the help rendered in analysing the data.

Division of Entomology, SNEHAMOY CHATTERJI.
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STUDIES ON THE MALE INFLORESCENCE OF *TRICHOSANTHES BRACTEATA* VOIGT.

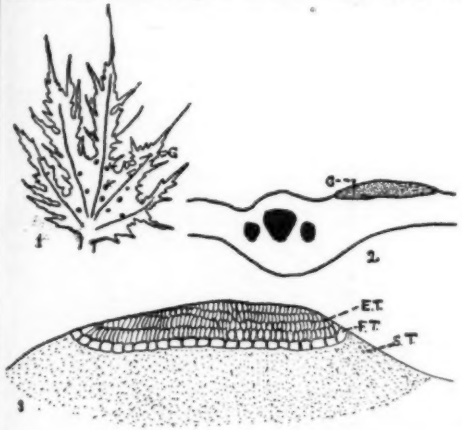
I. Anatomy of Bract

EACH flower of the male inflorescence of *Trichosanthes bracteata* Voigt. is protected by a large sessile bract with a broad sheathing base. The bracts are studded with some refractive glands and hairs are sparsely scattered along the surface (Fig. 1). Anatomical investigations on the bracts have been done to get an idea of their construction and to understand the physiological significance of the glands.

The material was collected from the Botanical Garden of Dacca University and was fixed and

killed in F.A.A. solution, dehydrated and embedded in paraffin according to schedule. Serial transverse sections were cut at 10-15 μ with a microtome and stained with safranin and light green.

Gross Anatomy.—Hairs are more on the lower surface while the glands are located on the upper surface. The cells of the bracts are all parenchymatous and not differentiated into palisade and spongy tissues. There are three vascular bundles present in one line at the midrib and the central one is larger than the two laterals which are almost equal to each other (Fig. 2).



FIGS. 1-3. *Trichosanthes bracteata* Voigt. Fig. 1. Complete bract with glands, × 5. Fig. 2. Transverse section of the bracts showing vascular bundles and glands, ×25. Fig. 3. Transverse section of the gland showing detailed structure, ×100.
G.—gland, E.T.—External excretory tissue, F.T.—Filter tissue, S.T.—Supply tissue.

Gland Anatomy.—The glands are widespread but shallow, their tangential extension being 17–25 μ and depth varying from ·034 -·04 μ.

The cup-shaped gland comprises of the usual three parts (Chakravarty, 1948, 1951) : (*a*) external excretory tissue or osmotic tissue; (*b*) filter tissue and (*c*) supply tissue (Fig. 3). The external osmotic tissue is only 3-4 layered and the cells are elliptical. This tissue is separated at the central part by single-layered filter tissue, the cells of which are conspicuously different from cells of other tissues by their almost quadrangular shape, almost parallel lateral walls and prominent thickening on them and also by their refractiveness. The cells of the external excretory tissue may easily be recognised even in absence of filter tissue by their comparative compactness and difference in staining capacity which probably indicate a difference in chemical contents. The cells of the supply tissue are closely packed.

The anatomy of the glands of bracts of *Trichosanthes fracteata* Voigt. shows almost the same picture as that of probract gland of *Coccinia indica* (Linn.) Cogn. (Chakravarty, 1951) but no vascular tissue has been observed here by the sides of the glands.

As these glands resemble the extrafloral glands of other cucurbits in anatomy it seems that they are also significant in exudation of excess water from the plant.

The authors are thankful to Mr. S. Khan, Lecturer in Botany, Dacca University, for permission to collect the material from the garden of the University.

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PRELIMINARY NOTE ON A METHOD FOR THE CYTOCHEMICAL DEMONSTRATION OF SUCCINIC DEHYDROGENASE IN LEPTOMONAD FORMS OF *LEISHMANIA DONOVANI*

GUHA *et al.*[1] have demonstrated the presence of mitochondria in the leptomonad forms of *L. donovani*. The association of these organelles with dehydrogenase activity has been amply demonstrated in animal tissue cells. With the use of Nitro B.T.—a *p*-nitrophenyl-substituted ditetrazole—smear techniques have been made possible with the advantages of better optical visualization, counterstaining and permanency.[3] With this in mind an attempt has been made to demonstrate this enzyme in the parasite. Using Pinacyanol,[2] the mitochondrial distribution was also studied.

Cultures of Leptomonad forms maintained on Row's medium were subcultured on N.N.N. medium and allowed to grow at 28-30° C. for 8-10 days. In order to increase the water of condensation, about 0·5 ml. of sterile normal saline was added to the medium just before it was inoculated. A minute drop of water of condensation was placed on microslides previously prepared with Pinacyanol and covered with a thin cover-slip. The edge of the cover-slip was sealed with vaseline and the microslide left in a closed petri-dish the bottom of which

was covered with a moist filter-paper. At the end of an hour the wet film was examined for the presence of mitochondria in the leptomonad forms. With Pinacyanol, mitochondria could be distinctly seen up to the end of four hours or so. After 24 hours although the parasite could be seen the granules had become indistinct.

The rest of the water of condensation was pipetted off into a Kahn tube, centrifuged at low speed for about 10 minutes and most of the supernatant fluid pipetted off leaving about 0·2 ml. of the fluid in the tube. To this was added 0·5 ml. of a solution containing p-nitro phenyl-substituted ditetrazole in phosphate buffer pH 7·6, sodium succinate and activators. It was then shaken gently to bring about an intimate contact between the parasite and the ingredients. The tube was then placed in an incubator for six hours at 37° C., after which the tube was again centrifuged at low speed for 15 minutes or so. The supernatant fluid was pipetted off leaving a small quantity in which the flagellates were resuspended by gently rolling the tube. A loopful of this suspension was smeared over grease-free microslides, allowed to dry thoroughly, fixed in absolute alcohol and counterstained with saffranin for 1-2 minutes. Dry fixed smears were also similarly stained.

FIGS. 1-2. Fig. 1 Camera lucida drawing showing the mitochondrial pattern with Pinacyanol in leptomonad forms of *L. donovani*. Fig. 2. Camera lucida drawing. showing the distribution of succinic dehydrogenase in leptomonad forms of *L. donovani*.

Dinitroformazan granules, fine as well as coarse, were present in the leptomonad form. The coarse granules were seen in forms that were club-shaped. In the typical elongated form the granularity was fine. The granules were scattered haphazardly throughout the cytoplasm of the parasite. The nucleus was devoid of formazan being ringed by a fine granularity. A fairly constant fine granule was seen in the cytoplasm at the flagellate end.

With Pinacyanol the mitochondria appeared as blue granules, some large, some fine scattered all over the parasite. A fine granule was seen near the tip of the flagellum in a few leptomonads.

Guha *et al.*[1] using triphenyl tetrazolium demonstrated formazan granules in the leptomonad form and stated that this was the reducing activity of one or many of several enzymic systems. The present study using a specific substrate, the highly reactive and least variable tetrazolium salt, has conclusively demonstrated the presence of succinic dehydrogenase in this flagellate. The alcohol fastness of the diformazan permits permanent smears which can be counterstained and conveniently examined with an oil immersion lens and not as a wet film preparation as required by the previous tetrazoles.

With Pinacyanol the mitochondrial distribution corresponds more or less to that described by Guha *et al.*[1] The dinitroformazan granules demonstrated in this study also correspond to the sites where mitochondria are present.

We are grateful to Dr. V. R. Khanolkar, Director, Indian Cancer Research Centre, Bombay, for the culture of *L. donovani* and to Dr. N. M. Purandare, Professor of Pathology and Bacteriology, Seth G. S. Medical College, Bombay, for the supply of N.N.N. Medium.

T. N. Medical College, Department of Anatomy, Bombay-8,
E. J. DE SOUZA.
S. N. KOTHARE.

October 26, 1959.

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REVIEWS

Isotopic Tracers. By Francis, Mulligan and Wormall. Second Edition; University of London. (Athlone Press), 1959. Pp. xx + 524. Price 52 *sh.* 6 *d.* net.

This is a very valuable theoretical and practical manual for biological students and research workers. The ever-increasing interest shown by the biochemist, physiologist, botanist, agriculturist and clinician, in the application of isotopic tracers made it imperative to hold practical courses in which handling of isotopes could be taught. The biochemical laboratory of St. Bartholomew Hospital Medical College, London, was among the first to introduce such courses. Hardly any one was more competent to write a book on it than the members of staff of that laboratory who were responsible for numerous important investigations in which radioactive isotopes found application in immunology and other fields of biochemistry and medicine. That within a life of five years a very enlarged second edition had been brought out (from pp. 306 to 524) speaks eloquently for its popularity, and usefulness.

The book is in two parts, the first theoretical and the second practical, about equal sizes. The first part has 13 chapters, while the second deals with measurements in eight experiments. Then follow 12 experiments on the use of labelled compounds of P 32, I 131, C 14, Na 24, Cr 51, Fe 59 and N 15, in determinations of plasma volume, circulations, localizations, etc. Also described is paper chromatography with I 131 containing urines.

The authors have everywhere revised and in many parts rewritten the text in order to take full account of the great advances made in the last five years, particularly in regard to instrumentation and the use of scintillation and gas counting techniques. The measurement of deuterium by the falling drop method is fully described, section on hazards brought up-to-date and an appendix included on safe methods of measuring, dispensing, and injecting radioactive solutions. New sections on isotopic investigations with vitamin B_{12}, on photosynthesis, on radioactivation analysis and on "self-radiation" labelling with tritium, are found. Separate chapter is devoted to kinetics of biological processes. Very well illustrated.

B. DASANNACHARYA.

Text-book of Physics. Second Edition Revised. Edited by R. Kronig. (Pergamon Press, 4 & 5 Fitzroy Square, London W. 1), 1959. Pp. xiv + 961. Price 84 *sh.*

This text-book, originally published in 1946 in the Dutch language, gives a comprehensive survey of classical as well as modern physics which will be useful not only to students of physics but also to chemists, biologists and medical students, for whom physics is only an auxiliary science. The book is brought out under the editorship of Prof. R. Kronig in collaboration with a number of authors actively engaged in physical research. This joint effort has enabled a fairly uniform standard, which may be taken as the graduate level, to be maintained in all the branches of the subject dealt with in the book. The popularity of the Dutch edition which went through as many as five editions in the course of a decade gave an incentive for an English translation, and the first English edition appeared in 1954. The success it has had since its publication had made necessary a second edition which is the one under review. This occasion has been taken to revise the book and bring it more up-to-date by amplifying the text in a number of places and by including, though briefly, new experimental techniques and procedures.

The main chapter headings under which different authors have made their contributions are the same as in the first edition, namely, (1) Mathematical Tools in Physics; (2) Mechanics; (3) Vibrations and Waves; (4) Electrodynamics; (5) Physical Optics; (6) Atomic Structure; (7) Atomic Theory of Heat; (8) Atomic Electricity; (9) Thermodynamics; (10) Electrical Instruments; (11) Optical Instruments and (12) Medical Physics.

Those who have used the first edition already know the value of the last chapter, Medical Physics, which is a novel feature not ordinarily found in physics text-books, and in the present edition the chapter has been revised in the light of recent developments in this growing field.

Another new feature in the second edition, which will be welcomed by the student-users of the book, is the inclusion of Problems and Answers at the end of each chapter.

A. S. G.

The Wealth of India—Raw Materials, Vol. V—H-K. (Council of Scientific & Industrial Research, New Delhi-1), 1959. Pp. 332. Price Rs. 30·00.

The fifth volume of this useful and authoritative publication of national importance, prepared under the direction of the Council of Scientific and Industrial Research, is in excellent keeping with the previous volumes and deals with the major Raw Materials and Industrial Products of India which come alphabetically under the letters H-K. As stated in the Introduction there are 380 entries of which 370 are on plants, 7 on animals and 3 on minerals, *viz.*, Iron ores, Jade and Kyanite. About two-thirds of the volume have been taken up by the detailed articles, running over several pages each, under the titles Helianthus (Sunflower), Hevea (Rubber), Hibiscus (including *H. esculentus*, Bhindi or Vendai, and *H. rosa-sinensis*, Shoe-flower or Semparuthi), Hordeum (Barley), Indigofera, Ipomdea (Sweet potato), Jasminum, Iron ores and Insects and pests.

About rubber cultivation and production we learn that in 1937-39 the acreage was 130,000 and production 14,000 tons while the corresponding figures for 1954 were 177,000 acres and 21,000 tons (p. 46). It is revealing to know that during the decade (1929-39), India was exporting annually over 2,000 tons of rubber to Malaya (p. 71). That until the end of the last century India was supplying the world market in indigo was past history. The advance of chemistry in the West has given a death blow to indigo cultivation in India. In 1896-97, about 1,700,000 acres were under indigo cultivation and the production of dye was about 170,000 cwt. The corresponding figures for 1955-56 were 10,600 acres and 2,600 cwt. (p. 173).

The article on "Insects and Insect Pests" covers nearly 50 pages and includes 5 plates and a large number of text-figures. It contains besides, about 200 references at the end. The whole is a condensed encyclopædia of information on insects and pests, their characteristics and distribution; their control and their beneficial effects, if any.

From the article on Iron ores we learn that Indian iron ore is one of the richest, so far as the iron content is concerned, in the world, about 65% (p. 257), that the annual production of iron in India is about 4,200,000 tons and that India has an estimated reserve of 6,790 million tons of high-grade iron ores of hematite and magnetite (p. 267).

The present volume and the volumes that have gone before speak for the consistency in the excellence of contents and get-up and there is no doubt, that the volumes to come will be of an equally high standard giving a wealth of information. The *Wealth of India* should be in the possession of all Libraries, Colleges, Research Centres, Industrial Concerns, Administrative Departments and Editorial Offices.

A. S. G.

Satellites and Spaceflight. By E. Burgess. (Chapman and Hall), 1957. Pp. vii + 159. Price 21 *sh.* net.

Though a pre-Sputnik publication, it contains, in its 159 pages all that is necessary to understand and clearly follow the developments connected with Sputnik, Lunik and Spaceflight, in an easy readable way. It is written strictly on a scientific basis, with adequate technical details. Instrumented satellites are described and their working and significance fully explained in the first chapter. Space stations and probing into space are similarly taken up in the next two chapters. Expedition to the moon and lunar base are treated in the next two. The final chapter deals with interplanatary flight. The book is well illustrated.

B. DASANNACHARYA.

Symposia of the Society for Experimental Biology—XIII. Utilization of Nitrogen and its Compounds by Plants. Edited by H. K. Porter. (Cambridge University Press), 1959. Pp. vii + 385. Price 50 *sh.*

This series published by the Society for Experimental Biology of the United Kingdom has already won the esteem of active research biologists the world over for the scholarly articles forming the subject-matter of symposia held under the auspices of the Society annually. This Thirteenth Volume, edited by the distinguished British Plant Physiologist Dr. Helen K. Porter, has a wide cross-section of current research subjects and concepts, all of them bearing on the utilization of nitrogen and its compounds by plants.

The Chapter headings range from metalloenzymes in nitrate assimilation, nitrogen fixation in legume and non-legume plants, nitrogen nutrition in the algæ, assimilation of amino-acids, amides, urease, urea and ureides in plants, biosynthesis of alkaloids and nucleic acids and plant growth and other related subjects. Indeed, it covers almost all that is worthwhile in understanding the role of nitrogen metabolism in

plant life. There are many facets of this fascinating problem in plant physiology that are not normally clearly understood and, in fact, no single text-book could be expected to cover this in entirety with limitations in pagination for chapters on nitrogen metabolism. It appears, therefore, that the advanced researcher in this field of rapid developments, ever since the discovery of chromatography as an analytical tool, does need an authoritative survey of recent events that create landmarks in understanding the subject and this lacuna is admirably filled by this publication. Quite rightly the emphasis has shifted in recent years to the organization of symposia on current topics and discuss them at a high level and publish them in an authoritatively edited symposia series. An attempt has been made in this direction in recent years in this country by scientific societies but to my mind if we are to produce a work of the kind now under review, it would perhaps need more sustained effort and, of course, greater thought on the proper choice of subjects and needless to add, the proper personnel that are to take part in them. When all this is done, the presentation and editing could be fashioned on the lines of this series and I can imagine it would be a proud day, indeed, for Indian Science.

I most warmly commend this delightful volume for serious study by all advanced students of plant physiology and may I say, animal physiology, for it is dreadful to imagine the creation of volume-tight compartments for the teaching of plant and animal physiology as it no doubt unfortunately exists at present in the minds of many teachers.

T. S. SADASIVAN.

Microbiology Yesterday and Today. Edited by Vernon Bryson. (Institute of Microbiology, Rutgers, the State University), 1959. Pp. v + 122. Price $ 4.00.

This small book is a compilation of the proceedings of a Symposium held during 1958 at Rutgers, New Jersey, in honour of the seventieth birthday of, and as a fitting tribute to, Dr. Selman A. Waksman, Nobel-Leureate and Professor Emeritus at the Institute of Microbiology. Dr. Waksman's association with the New Jersey Agricultural Experiment Station and in the development of antibiotics including the renowned streptomycin has made New Jersey the Mecca of soil microbiologists and researchers in antibiotics from all over the world. It is appropriate, too, that Dr. Waksman should be honoured this way as he has used the material rewards of his discoveries to further the scientific work to which he has devoted well over forty years of his life.

The volume contains seven chapters that vary greatly in their significance to the microbiologist and in scope attempts at spanning "a period of history enlightened by Dr. Waksman's own numerous and important contributions" to the subject. Though all of them collectively offer a wealth of information on microbiology (and microbiologists) of yesterday and today, those of special interest to specialists are: "Microbial Biochemistry and Its Development" by J. H. Quastel; "Antibiotics—a New Field for Microbiological Research and Perspectives for the Future" by H. B. Woodruff; "Episodes in Immunochemistry" by M. Heidelberger; "Bacterial Classification—Problems and Developments" by S. T. Cowan; and "Some Contributions of Genetics to Microbiology" by V. Bryson. The chapter on "Aspects of Russian Microbiology" by G. K. Skiabin of the Academy of Sciences, U.S.S.R. and that on "Microbiology—Yesterday and Today" by Waksman are noteworthy in that whereas the former traces the development of Russian microbiological science which "has had a good yesterday and great today" the latter attempts to show how much this science "which owed much of its origin to the information and techniques of other fields appears to repay its debt in a most efficient manner by furnishing invaluable information, model systems, and technical tools to other sciences". The book will be read with interest by all.

J. V. B.

Solvent Extraction of Vegetable Oils. A Monograph by Shri H. V. Parakh. (Published by Indian Central Oilseeds Committee, "Gandhi Bhavan", Hyderabad-1 Dn.), 1958. Pp. 210.

Considering that even in the industrially more advanced countries of the West, no book has been published on this subject so far, it is indeed very bold of Shri H. V. Parakh to have attempted to do so. The Author has reviewed different methods of production of vegetable oils and discussed theoretical aspects of solvent extraction and then gone on to solvent extraction machinery and processes involved, in the third chapter. In subsequent chapters, the Author has dealt with various other aspects, such as the application of solvent extraction to various seeds, the important question of solvents, and economics of the process.

The Author has tried to make out a case for linking the bullock ghani industry, with solvent extraction, and in the last chapter has briefly discussed the future development of the industry in India.

There is definitely a future for the solvent extraction industry in India ; hence the industrial entrepreneur as well as the student of Oil Technology will greatly welcome the advent of this book. More details, regarding different types of machinery, processes and cost data, would have made the volume still more useful, and it is hoped that the Author will try to include these in the next edition.

S. A. SALETORE.

Zoogeography. Edited by Carl L. Hubbs. (American Association for the Advancement of Science), 1958. Pp. 509. Price $ 12.00.

One of the notable activities of the American Association for the Advancement of Science is the Organization of Symposia of general interest which the Association presents in the form of well-edited reports. The present volume is the 51st of the series and summarizes the proceedings of two symposia relating to (*a*) The origins and affinities of the land and freshwater fauna of Western North America and (*b*) Geographic distribution of contemporary organisms. Seventeen contributors present results of their work relating to the origin, distribution and evolution of the animals which have formed the special field of their study. Practically all this work relates to the United States of America. The physical features and climate are dealt with by King and MacGinitie. Interesting general conclusions are drawn by Bartholomew on the question of the distribution of many invertebrates in terms of their physiological tolerances while among vertebrates, behavioural and ecological factors determine distribution. The problems of the distribution of land mammals in time and space are dealt with in two papers by Savage and Burt, which constitute a modern assessment of the faunal structure in North America. Special groups like Butterflies and Beetles are also dealt with adequately.

The contributions are so marked with diversity that perhaps coherence might appear lacking. But in this vast field, both are inevitable and even necessary. The laws governing the distributions of animals are so diverse that they permit no universal application. Each group follows a different pattern, both in space and in time. The object of this volume is to direct attention to this.

B. R. S.

Journal of the Marine Biological Association of India. Vol. I, No. 1. (Marine Biological Association, Mandapam Camp, S. India), June 1959. Pp. xxv + 112. Price Rs. 12·50.

The Journal is the official organ of the Marine Biological Association of India established at Mandapam Camp, and "devoted to all branches of Marine Biology and cognate sciences in India and abroad", and is published twice a year in June and December. The present review deals with the first number of the Journal published in June 1959, which contains three sections. The major and more important first section contains thirteen articles, several of them original, contributed by various authors, Indian and foreign, on marine biological and oceanographical topics. The minor second section is devoted to short notes and news and comments, while the third, the service section, provides authentic information to research workers and students undergoing training in marine biological sciences and to educational institutions in regard to collection and study of live biological material in suitable niches in various localities round about the Pamban group of islands in the Gulf of Mannar.

Marine biology is a relatively old scientific discipline even in India where its foundations were laid under official auspices by British biologists working in India since the latter half of the 19th century. Much of our knowledge of life in the seas around us garnered by these pioneers was, however, confined to the pages of special Government publications which virtually remained a sealed book to the educated Indian public until marine biological investigation came to be recognised as an important branch of field sciences in the Universities of Madras and Bombay, and the results of such investigation were published in small journals of their own. With the establishment of more biological laboratories on the coasts in connection with University teaching at Waltair, Annamalainagar and Trivandrum, and of fishery research stations on both the coasts of India under Central Government auspices, there has been an appreciable increase in the number of investigators and in the output of work on marine biological subjects such as to warrant the founding of journals like the *Indian Journal of Fisheries* and the *Andhra University Memoirs in Oceanography*. It is therefore a sign of happy augury for progress in marine biology to have this latest recruit, the *Journ. Mar. Biol. Ass. India*, to the ranks of scientific journals in India.

The Journal is well printed and got up, and the choice of the Marine Survey Ship "Investi-

gator" of the Indian Navy as the front cover-page illustration is happy. It is to be hoped that no efforts will be spared to maintain a high standard for the Journal both in its contents and in general get-up.

H. S.

Melchior Treub. By H. H. Zeijlstra. (Koninklijk Instituut Voor Ds. Tropen, Amsterdam, Mauritskade 63, Amsterdam-Oost), 1959. Pp. 127. Price not given.

The book describes the life and scientific work of the famous Dutch Botanist Dr. Melchior Treub, who for a period of nearly 30 years, 1880-1909, worked in Buitenzorg, Netherlands Indies. His Directorship of the Botanical Gardens at Buitenzorg (now called Bogor) has in no small measure been responsible for the world-wide recognition and fame this station attained in later years. Chiefly due to his initiation and efforts several famous Botanists of Europe had spent some time in Buitenzorg and made valuable contributions to botanical problems of tropical plant life, particularly of Malayan Archipelago.

The book gives interesting details about the development of Buitenzorg gardens, with a large number of research centres devoting attention to plantation crops like sugarcane, tobacco, coffee, tea, cinchona, cocoa, etc. The garden had also developed a comprehensive herbarium on the "flora" of Netherlands Indies. Although Dr. Treub's work at the initial stages was mainly concerned with studies on plant physiology and ecology, he was later actively advising and controlling the scientific work of the several research stations dealing with these special crops.

The perusal of the book gives a clear picture of how eminent scientists towards the close of last century had to labour hard to establish agricultural research against strong conservative tendency and opposition from administrative officers. The book is well written and though it deals mainly with the life of Dr. Treub, it also gives the historical background of the development of scientific agriculture in South-East Asia.

K. R.

Books Received

Reproduction in Domestic Animals, Vol. I. Edited by H. H. Cole and P. T. Cupps. (Academic Press, New York; India: Asia Publishing House, Bombay-1), Pp. xiv + 651. Price $ 14.50.

Hormones and Atherosclerosis. Edited by G. Pincus. (Academic Press, New York), 1959. Pp. xvi + 484. Price $ 13.50.

Fundamentals of Electronics. Second Edition. By F. H. Mitchell. (Addison-Wesley Publishing Company, Reading, Massachusetts, U.S.A.), 1959. Pp. xi + 260. Price $ 6.50.

The Prof—A Personal Memoir of Lord Cherwell. By R. F. Harrod. (Macmillan & Co. Ltd., St. Martin's Street, London W.C. 2), 1959. Pp. xv + 281. Price 25 *sh.*

Illustrated Genera of Rust Fungi. By G. B. Cummings. Burgess Publishing Co., Minneapolis, 15, Minn.), 1959. Pp. ii + 131. Price $ 4.50.

The Human Integument. Edited by S. Rothman. (American Association for the Advancement of Science, Washington-5 D.C.), 1959. Pp. x + 260. Price $ 5.75.

Annals of the New York Academy of Sciences, 1959—

Vol. 79, Art. 3: *Psychological Reactions to Novel Stimuli: Measurement, Adaptation and Relationship of Psychological and Physiological Variables in the Normal Human.* By R. A. Dykman, W. G. Reese and others. Pp. 43-107. Price $ 2.50.

Vol. 80, Art. 2: *Hypothermia.* By A. C. Taylor and others. Pp. 285-550. Price $ 3.50.

Vol. 81, Art. 3: *Enzymes of Polynucleotide Metabolism.* By J. S. Roth. Pp. 551-804. Price $ 5.00.

Vol. 82, Art. 1: *Recent Contributions to Antibacterial Therapy.* By P. S. Rhoads and others. Pp. 1-90. Price $ 2.50.

Applications of the Theory of Matrices. By F. R. Gantmacher. (Interscience Publishers, New York), 1959. Pp. ix + 317. Price $ 9.00.

Out of the Sky—An Introduction to Meteoritics. By H. H. Nininger. (Dover Publications, New York-14), 1959. Pp. viii + 336. Price $ 1.85.

The Realm of the Nebulæ. By Edwin Hubble. (Dover Publications, New York-14), 1959. Pp. xiv + 207. Price $ 1.50.

Physics and Geology. By J. A. Jacobs, R. D. Russell and J. Tuzo Wilson. (McGraw-Hill Book Co., New York-36), 1959. Pp. xii + 424. Price $ 9.75.

Blakeslee: The Genus Datura. By A. G. Avery, S. Satina and Jacob Rietsema. (The Ronald Press Co., New York-10), 1959. Pp. xiii + 289. Price $ 8.75.

SCIENCE NOTES AND NEWS

Field Rat as Predator on Locust Hoppers

Messrs. D. R. Bhatia and Pritpal Singh report from the Field Station for Investigations on Locusts, Bikaner, that during July-August, 1959, field rats were observed predating upon third to fifth instar hoppers of the desert locust, *Schistocerca gregaria* Forsk., congregated on bushes, in Kantia area of Nagaur District and Tendesar area of Churu District (Rajasthan). On one occasion a rat removed to its burrow five hoppers in five minutes, carrying one at a time. This is probably the first record of rats predating on locusts.

Occurrence of Ergot in Bajra in Rajasthan

Shri Lalit Mohan Mathur, District Agriculture Officer, Sirohi (Rajasthan), recorded ergot disease on bajra (*Pennisetum typhoides*) in Mandar and adjoining villages of Reodar Tehsil, Sirohi District. The disease is caused by the fungus of *Clavicaps* sp. and was observed both as conidial infection as well as Sclerotia. The identification was confirmed by Dr. N. Prasad, Plant Pathologist, Rajasthan.

Award of Research Degrees

Andhra University has awarded the D.Sc. Degree in Geo-physics to Sri. M. Sankara Rao for his thesis entitled "Studies on Heat and Momentum Transfer in Atmosphere".

Osmania University has awarded the Ph.D. Degree in Physics to Sri. V. S. Raghavendra Rao for his thesis entitled "Viscosity and Light Scattering Studies of High Polymer Solutions".

Pioneer V—the U.S. Sun Satellite

On March 11, 1960, the United States successfully launched a new deep space probe, Pioneer V, expected to go into orbit around the Sun. The spherical payload 26" in diameter and weighing 90 lb. was launched by the three-stage Thor-Able rocket from the missile test centre at Cape Canaveral (Florida).

The giant radio telescope at Jodrell Bank picked up the signals from the satellite 12 minutes 10 seconds after launching time, and has been contacting the satellite at regular intervals.

Some of the special features of Pioneer V would be: (1) It would go nearer the Sun—an average of 80 million miles—than any space probe so far launched; (2) its orbit around the Sun would be roughly midway between the orbits of Venus (67 m. miles from Sun) and of the earth (93 m. miles from Sun); and (3) its transmitter believed to be the most powerful ever flown in deep space experiments would permit communication between the earth and the payload at distances up to 50 million miles.

Lunik I the Russian satellite, launched on January 2, 1959, and Pioneer IV the U.S. deep space probe launched on March 3, 1959, both exceeded the second cosmic speed (7 miles/sec.) to become artificial planets of the Sun.

Photo-Piezoelectric Effect in Semiconductors

A new photo-voltaic effect is observed in semiconductors in which the pressure is not homogeneously distributed. This is called the photo-piezoelectric effect.

The condition for the production of a photo-voltage in a semiconductor is the simultaneous presence of non-equilibrium carrier concentration and of an inhomogeneity. The most important inhomogeneity is the variation of the concentration of donors or acceptors along the sample. It is known that with semiconductors the energy gap E_G usually varies with the pressure. The idea arises of studying the production of an emf in a semiconductor in which the inhomogeneity is produced by non-homogeneous compression.

Experiments were carried out on single crystal specimens of *n*-type, and *p*-type germanium, *p*-type silicon cut normal to the (111) direction. The samples were ground into the shape of prisms $1 \times 1 \times 15$ mm. During measurements they were fixed in a vice which was shifted by means of an exact screw. The illumination was confined to a fixed light spot $0{\cdot}2 \times 1$ mm., and the pressure applied at two points was measured by means of a dynamometer. The voltage produced at the ends of the prisms was amplified by a narrow-band amplifier and measured with a valve voltmeter. Results were in agreement with the explanation that the effect is caused by the dependence of the energy gap on the pressure. Thus inhomogeneous distribution of the internal stresses in semiconducting crystals, which are photoelectrically sensitive, can lead to the production of the photo-piezoelectric effect.—*Czech. J. Phys.*, 1959, 9, 572.

Television and the Electron Microscope

An experimental system which promises to transform the work of electron microscopists figured in the BBC's "Science International" television programmes.

The normal visual image in an electron microscope is hard to see. In the new system, developed by Metropolitan-Vickers, the microscope's high-energy electrons fall on a selenium screen each releasing several thousand electrons in the selenium and so increasing its conductivity. A low-energy electron beam scans the selenium and from an electrode backing on the selenium one obtains intensified television signals, depending on the strength of the microscope's rays at each point. On the television display unit the specimen appears magnified about a million times.

100-Inch Mass Spectrometer

A new double focussing 100-inch radius mass spectrometer has been built at the Argonne National Laboratory. To obtain maximum stability the electrostatic analyser is made of gold-coated fused quartz mounted on a 5-ton slab of granite. The magnetic analyser is a 14-ton permanent magnet mounted on a movable carriage to allow for focussing.

The new machine will be used in a search for curium-247 in nature, for uranium assays of meteorites, for a precise determination of the half-life of cæsium-137 and for analysing the reaction products from the Zero Gradient Proton Synchrotron now under construction at Argonne.

Electrically Treated Cotton

Weak electric currents are being used in attempts to render cotton-seed and fibre more water-absorbent and to make cotton yarn stronger. The experiments, in the US Department of Agriculture, place seed and fibre in a partially evacuated glass tube and pass a current of 10-50 milliamps through the tube.

Seed treated in this way was found to take up more water than usual and it is thought that this increased absorption may have a bearing on seed germination, survival, growth and yield of cotton. Thus corn seeds exposed to the electrical radiation germinated somewhat faster and more uniformly than untreated seed. It is not yet fully understood how the current acts on the plant material and a three-year test has been initiated in three states to evaluate the electric treatment.

When cotton fibre is subjected to the glow discharge, its surface becomes roughened and the wax coating is found to be pierced in many places. The roughened surface affects the yarn's breaking strength which is stated to be 20% better than that of untreated yarn.

As materials differ in their radiation tolerance, the process is also expected to prove useful in getting rid of weed seeds mixed with cotton-seeds.

Symposium on 'Minor Batch Constituents in Glass Melting'

A symposium on 'Minor batch constituents in glass melting' organised by the Central Glass and Ceramic Research Institute, Jadavpur, Calcutta-32, India, was held at the Institute on February 4 and 5 (1960).

The symposium was inaugurated by Lala Shri Ram. The inaugural session was presided over by Shri D. N. Sen.

Introducing the subject of the symposium, Dr. Atma Ram, Director of the Institute, outlined the role of minor batch constituents in melting of glass, with particular reference to fining, colouring and decolorising of glass. He emphasised the need for rigid control over addition of minor constituents to the batch for melting of glass, not only to obtain good quality glass but also to achieve economy in production. For example, for fining of glass arsenic and nitre and for decolorising selenium and cobalt were added in small quantities to the glass batch. In cases where more than the requisite amount of arsenic was used in the glass batch, arsenic did not enhance fining, on the other hand it necessitated larger amount of selenium to be used for decolorising.

Solar Spectra from Rocket Flights

The two rocket flights, known as the Aerobee-Hi flights, at Holloman Air Force Base, New Mexico, on June 4, 1958, and March 30, 1959, were used to photograph spectra of the sun from high altitudes. Both rockets achieved heights of over 200 km. A modified grazing-incidence concave grating spectrograph, with a theoretical resolving power of 4800 in the first order, was employed and the spectra were taken on Eastman Kodak SWR film. The spectrograph was pointed towards the sun by a biaxial pointing control. The zenith angles of the sun at the time of the two flights were about 80° and 60° respectively. In each instance, rocket performance and spectrograph orientation were satisfactory, and a near-perfect parachute recovery was made.

A number of exposures were made during each flight by using a present timer in the rocket which activated a shutter and a film-transport mechanism alternately throughout the flight. The spectrograms show about 150 emission lines in the extreme ultraviolet in the range between 1216 Å (H-Lyman alpha) and 83·9 Å. The most conspicuous feature of the spectrum was the resonance line of ionized helium 303·8 Å, which was sufficiently intense to be photographed in 3 orders.

The results of the analysis lead to the conclusion that the character of the solar spectrum in the extreme ultraviolet is similar to a spectrum in this region that results from optical transitions in highly ionized atoms of a high temperature gas, such as the outer chromosphere and the solar corona. Lines of neutral or ionized oxygen, carbon, nitrogen, helium and silicon have been identified. Thus there are lines due to H, He II; C I, C II, C III, N I, N II, N III, Si III, O I, O II, O III, O IV, O V and O VI. The shortest wavelength 83·9 Å may be due to Ne VIII or Fe XI—(*Astrophy. Jour.*, 1959, 130, 954).

Protactinium Stock

From 60 tons of waste material from the production of uranium from its ores, chemists at Windscale have with some difficulty extracted 100 g. of protactinium. This is the extremely rare element No. 91, formed chiefly by the radioactive decay of uranium-235. It was discovered by O. Hahn and L. Meitner in 1917.

A change in the uranium separation process at Springfields means that future wastes are unlikely to be suitable for protactinium recovery. The U.K. Atomic Energy Authority believes that it now holds most of the World's stocks of protactinium, worth £ 1,000 per gramme.

New Wind Tunnel for High Speeds in Amsterdam

A new wind tunnel for supersonic speeds has been put into operation at the National Aeronautic Research Institute in Amsterdam.

The tunnel, with a length of 466 feet and a total weight of 1 million kg. (1000 M.T.), contains a small ($6\frac{1}{2}' \times 5 \cdot 3' \times 8\frac{1}{2}'$) space in which a wind velocity can be reached of 1·3 times the velocity of sound (*i.e.*, about 1,500 km. 930 miles per hour). The power output required to set the air in motion is 20,000 h.p. and is supplied by a turboelectric power station.

A supersonic wind tunnel plant in which speeds 6 times that of sound can be reached is under construction at the Laboratory.

Total investment in these tunnels is about seven million guilders (Rs. 90 lacs).—(*Royal Netherlands Embassy, New Delhi: Science News*).

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